ADNOC GROUP PROJECTS AND ENGINEERING

ISOLATION VENT AND DRAIN PHILOSOPHY

Philosophy

AGES-PH-08-001

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أدنــوك
ADNOC

GROUP PROJECTS & ENGINEERING / PT&CS DIRECTORATE

CUSTODIAN	Group Projects & Engineering / PT&CS
ADNOC	Specification applicable to ADNOC & ADNOC Group Companies

Group Projects & Engineering is the owner of this Specification and responsible for its custody, maintenance and periodic update.

In addition, Group Projects & Engineering is responsible for communication and distribution of any changes to this Specification and its version control.

This specification will be reviewed and updated in case of any changes affecting the activities described in this document.

INTER-RELATIONSHIPS AND STAKEHOLDERS

a) The following are inter-relationships for implementation of this Specification:

   i. ADNOC Upstream and ADNOC Downstream Directorates and

   ii. ADNOC Onshore, ADNOC Offshore, ADNOC Sour Gas, ADNOG Gas Processing. ADNOC LNG, ADNOC Refining, ADNOC Fertilisers, Borouge, Al Dhafra Petroleum, Al Yasat

b) The following are stakeholders for the purpose of this Specification:

   ADNOC PT&CS Directorate.

c) This Specification has been approved by the ADNOC PT&CS is to be implemented by each ADNOC Group company included above subject to and in accordance with their Delegation of Authority and other governance-related processes in order to ensure compliance

d) Each ADNOC Group company must establish/nominate a Technical Authority responsible for compliance with this Specification.

DEFINED TERMS / ABBREVIATIONS / REFERENCES

"**ADNOC**" means Abu Dhabi National Oil Company.

"**ADNOC Group**" means ADNOC together with each company in which ADNOC, directly or indirectly, controls fifty percent (50%) or more of the share capital.

"**Approving Authority**" means the decision-making body or employee with the required authority to approve Policies & Procedures or any changes to it.

"**Business Line Directorates**" or "**BLD**" means a directorate of ADNOC which is responsible for one or more Group Companies reporting to, or operating within the same line of business as, such directorate.

"**Business Support Directorates and Functions**" or "**Non- BLD**" means all the ADNOC functions and the remaining directorates, which are not ADNOC Business Line Directorates.

"**CEO**" means chief executive officer.

"**Group Company**" means any company within the ADNOC Group other than ADNOC.

"**Guideline**" means this Process Design Criteria.

"PSR" means Process Safety Requirement

TABLE OF CONTENTS

INTER-RELATIONSHIPS AND STAKEHOLDERS .... ERROR! BOOKMARK NOT DEFINED.
1 FOREWORD ... 6
2 PURPOSE ... 6
3 SCOPE ... 7
4 DEFINED TERMS / ABBREVIATIONS / REFERENCES ... 7
5 NORMATIVE REFERENCES ... 9
6 REFERENCE DOCUMENTS ... 9
6.1 ADNOC SPECIFICATIONS ... 9
6.2 STANDARD DRAWINGS ... 9
6.3 OTHER REFERENCES (OTHER CODES/IOC STANDARDS) ... 9
7 DOCUMENTS PRECEDENCE ... 9
8 SPECIFICATION DEVIATION/CONCESSION CONTROL ... 10
9 ISOLATION ... 11
9.1 DEFINITION ... 11
9.2 FLUID CATEGORISATION ... 11
9.3 TYPES OF ISOLATION. ... 11
9.4 SELECTION SPECTACLE BLIND OR SPACER ... 11
9.5 VALVED ISOLATION ... 12
9.6 POSITIVE ISOLATION [PSR] ... 14
9.7 BLEEDS CONFIGURATION & ROUTING ... 16
9.8 ISOLATION OF SYSTEMS AND EQUIPMENT FOR MAINTENANCE ... 18
10 EQUIPMENT VENTS & DRAINS ... 42
10.1 INTRODUCTION ... 42

10.2 EQUIPMENT & PIPING 42

11 DRAINAGE SYSTEMS 46

11.1 PURPOSE 46

11.2 CLASSIFICATION 46

11.3 ONSHORE OPEN DRAIN SYSTEMS 49

11.4 ONSHORE CLOSED DRAIN SYSTEMS 50

11.5 OFFSHORE DRAINAGE SYSTEMS 52

11.6 COLLECTION OF DRAINAGE EFFLUENT 53

1 FOREWORD

This philosophy is to be applied across all business units within ADNOC. However, it is advised that all projects should develop a Project Isolation Philosophy based on the project requirements.

2 PURPOSE

This philosophy provides requirements, recommendations, and permissions for selection, design and installation of mechanical, instrument and control equipment for isolation for maintenance and emergency conditions.

This philosophy is applicable to the following:

i. Design and installation of new plants and facilities;
ii. Modification of existing plants and facilities;
iii. Supplier and supplied skid mounted units.

Objectives of the Isolation Philosophy are as follows:

i. Define safe & cost-effective methods to facilitate plant maintenance and inspection to meet maintenance requirements with minimum loss to production;
ii. To ensure operability and safety during commissioning, normal operation, start up, shutdown and maintenance;
iii. Define the facilities and arrangements required for systems/equipment/instruments draining, venting, purging;
iv. Define isolation for control valve arrangements;
v. Define isolation requirements and configuration for relief systems;
vi. Define isolation methods required for phased additions / removal of systems and equipment;
vii. Define isolation requirements for plant battery limits;
viii. To prevent contamination of systems;
ix. To provide standard utility supply connections arrangements.

Objectives of the Drain and Vent Philosophy are as follows:

i. Define the drain and vent requirements for equipment, instrument and process systems;
ii. Explain the categorisation and design criteria of various drain systems.

3 SCOPE

This philosophy covers the following systems:

i. The different methodologies available for the isolation of process equipment, systems and plant units (Section 9);
ii. Drain and vent requirements for various types of process equipment and systems (Section 10);
iii. Drainage systems for both onshore and offshore facilities (Section 11).

This philosophy has the following exclusions

i. Depressurisation which will be covered in Flare and Blowdown Philosophy [2],
ii. Equipment design conditions for drainage vessels and pumps which will be covered in Process Design Criteria [3].

4 DEFINED TERMS / ABBREVIATIONS / REFERENCES

Abbreviations	
AOC	Accidentally Oil Contaminated
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
CSO	Car Sealed Open
CSC	Car Sealed Closed
DBB	Double Block and Bleed
FB	Full Bore
FC	Fail Closed
FL	Fail Last Position
FO	Fail Open
HAZOP	Hazard and Operability Study
HP	High Pressure
ILC	Interlocked Closed
ILO	Interlocked Open

Abbreviations	
LC	Locked Closed
LEL	Lower Explosion Limit
LG	Level Gauge
LNG	Liquefied Natural Gas
LO	Locked Open
LOPA	Layer of Protection Analysis
LP	Low Pressure
LPG	Liquefied Petroleum Gas
LT	Level Transmitter
NC	Normally Closed
NGL	Natural Gas Liquids
NPS	Nominal Pipe Size
MP	Medium Pressure
OD	Open Drain
PMS	Piping Material Selections
PSV	Pressure Safety Valve
RS	Removable Spool
SBB	Single Block and Bleed
SDV	Shutdown Valve
WHT	Wellhead Tower

5 NORMATIVE REFERENCES

International Code(s) and Standards

References
1. API 520 Part II – Sizing, Selection and Installation of Pressure Relieving Devices

6 REFERENCE DOCUMENTS

References
2. AGES-PH-08-002 Flare and Blowdown Philosophy
3. AGES-GL-08-001 Process Design Criteria
4. AGES-SP-09-002 Piping Material Specification Index
5. AGES-SP-09-001 Piping Basis of Design

6.1 ADNOC Specifications

None at present

6.2 Standard Drawings

None at present

6.3 Other References (Other Codes/IOC Standards).

None at present

7 DOCUMENTS PRECEDENCE

The specifications and codes referred to in this specification shall, unless stated otherwise, be the latest approved issue at the time of project award.

It shall be the CONTRACTOR'S responsibility to be, or to become, knowledgeable of the requirements of the referenced/related Codes and Standards.

Resolution and/or interpretation precedence shall be obtained from the COMPANY in writing before proceeding with the design.
In case of conflict, the order of document precedence shall be:

- UAE Statutory requirements
- This philosophy document
- Project documents
- International codes and standards

8 SPECIFICATION DEVIATION/CONCESSION CONTROL

None at present

9 ISOLATION

9.1 Definition

In general, sufficient isolation shall be provided to ensure that safe, satisfactory isolation of each piece of equipment, instrument and system is achieved. Isolation of equipment, instruments and piping/pipeline is required for a variety of reasons, including:

i. Maintenance performance;
ii. Preventing flammable or hazardous material release to atmosphere;
iii. Avoiding contamination of products;
iv. Avoiding unwanted transmission of products (flammable/very toxic/asphyxiation/utilities);
v. Diverting a product elsewhere;
vi. Quick stopping of a product fluid in case of emergency;
vii. Diversion of a product fluid to a flare/blowdown/safe location;
viii. Allowing safe entry of personnel into process equipment;
ix. Providing suitable isolation to permit easy installation of future equipment;
x. Start-up, shutdown for inspection, tie-ins and loss prevention;
xi. Pressure testing and leak testing before commissioning and start-up;
xii. Purging of equipment or piping with nitrogen to make it hydrocarbon free;
xiii. Avoiding any loss of inventory.

The requirement for isolation is generally dependent on operating/maintenance philosophy, the extent of shutdown, the hazardous nature of contained fluid and the operating pressure / design pressure rating of piping system.

9.2 Fluid Categorisation

Refer to AGS-GL-08-001 Process Design Criteria Section 10 for fluid categorisation [3].

9.3 Types of Isolation.

The process and safety requirements for the isolation, combined with desired inherent integrity and time required to isolate, will determine the method of isolation selected.

Isolation can be categorised into two types:

1) General valved isolation;

2) Positive isolation used where breaks in containment or man entry is required by insertion of a spade, or removal of a spool piece or swinging of a spectacle blind.

9.4 Selection Spectacle Blind or Spacer

The selection of a Spectacle Blind or Spacer/Spade for various sizes and pipe classes will be determined by the Piping Material Specification [4].

9.5 Valved Isolation

Valved isolation is generally considered to maintain containment and is acceptable option in low risk (non-hazardous) and where no manual entry is required e.g., control valve maintenance, etc. Valved isolation is also used to enable positive isolation to be installed or removed without the need for complete shutdown/depressurization.

Valved isolation can be a "Single block and bleed" (SBB) or "Double block and bleed" (DBB).

Table 9.1: Valve Isolation Selection for Fluid Type and Pressure Rating

Fluid Type	**Pressure Rating**			
	150#	**300#**	**600#**	**900#**
Hazardous (Process) Fluids – Non-Toxic				
Hydrocarbon Gas	SBB	SBB	SBB	DBB
Hydrocarbon Liquid	SBB	SBB	SBB	DBB
Water containing dissolved HC/H2S (Produced Water/disposal water)	SBB	SBB	SBB	DBB
Upstream multiphase infield Pipelines	SBB	SBB	SBB	DBB
Liquid / Product Export Pipelines	SBB	SBB	DBB	DBB
Pipeline Gas Export	SBB	SBB	DBB	DBB
Fluids with hydrogen above LEL (above 4% by vol)	SBB	SBB	DBB	DBB
Sour water service (Free water containing equal to or greater than 50 ppmwt dissolved hydrogen sulphide)- Note-3	SBB	SBB	DBB	DBB
Hazardous (Process) Fluids – Toxic / Lethal [PSR]				
Hydrocarbon Gas	DBB	DBB	DBB	DBB
Hydrocarbon Liquid	DBB	DBB	DBB	DBB
Water containing dissolved HC/H2S (Produced Water/disposal water)	DBB	DBB	DBB	DBB
Upstream multiphase infield Pipelines	DBB	DBB	DBB	DBB
Liquid / Product Export Pipelines	DBB	DBB	DBB	DBB
Pipeline Gas Export	DBB	DBB	DBB	DBB
Fluids with hydrogen above its LEL (above 4% by vol)	DBB	DBB	DBB	DBB
Amine	DBB	DBB	DBB	DBB
Hazardous Utilities				
Hot Oil	SBB	SBB	NA	NA
Methanol	SBB	SBB	SBB	DBB
TEG/MEG	SBB	SBB	SBB	DBB
Hot Water > 60 ^{o}C	SBB	SBB	SBB	DBB
DM water	SBB	SBB	SBB	DBB
BFW (HP)	SBB	SBB	SBB	DBB
Non-Hazardous Utilities				
Diesel	SBB	SBB	SBB	DBB
Nitrogen	SBB	SBB	SBB	DBB
CO2>90%	SBB	DBB	DBB	DBB
Compressed Air	SBB	SBB	SBB	DBB
Steam (Note 2)	SBB	SBB	SBB	DBB
Potable Water	SBB	SBB	SBB	DBB
Injection Water (upstream)	NA	SBB	SBB	SBB
Fire Water	SBB	SBB	NA	NA
Fresh Water	SBB	SBB	NA	NA
Sea Water	SBB	SBB	SBB	SBB
Cooling Water	SBB	SBB	NA	NA

Note 1: For Chemicals, refer to MSDS for assessing the hazardousness/toxicity and follow the above guideline for SBB versus DBB.
Note 2: Battery limit valves shall be doubled for steam pressure more than 35 barg
Note-3: Applicable for Refinery Business Unit only for wet H_2S service/sour service with frequent use, as defined in accordance with NACE MR0103 / ISO 17945 for Refinery service.

9.6 Positive Isolation [PSR]

9.6.1 Positive Isolation

Positive isolation is achieved when a guaranteed physical separation at the isolation point is required. This type of isolation is required for:

i. Hot work on isolated systems;
ii. Equipment to be pressure tested;
iii. When equipment is to be opened and entry by personnel is required for inspection or maintenance or equipment to be removed whilst the remainder of the unit is still under operation;
iv. Boundary / Battery limit isolation between running and offline systems;
v. Long term isolation, normally unattended installations, import and export lines and future expansion tie- ins;
vi. Isolation of equipment from live systems subject to emergency or maintenance releases i.e., flare, drains and vents;
vii. If entrained solids are present in the system;
viii. To prevent contamination during normal operation of utility supplies e.g., Water, IA, Nitrogen etc, when these are permanently connected to the process units.

Positive isolation can be achieved in one of the following ways. Please ensure execution of valve isolation as a precursor to positive isolation according to Table 9.1.

i. Removal of a spool piece and blanking/blinding of open end with blind flanges. Spool pieces are preferred for equipment items that require removal e.g. pumps, compressors, exchanger tube bundles / heads. For piping specifications that call for seal ring and hub fittings, provision shall be made to allow the spool to be depressurised prior to its removal. Removable spools shall be provided at the inlet of pressure safety valves (common inlet of multiple PSVs) as well as blowdown valve connections for achieving positive isolation of the equipment/vessel. Removable spool pieces should not contain any instrumentation or piping connection;
ii. The turning to blind position of a spectacle blind;
iii. The insertion of a spade (blind) between flanges or replacement of a spacer with line blind. Refer to the piping design specification [4] for the selection of the spacer/blind.

Spectacle blind / spade / spacer / blind flange shall have the same ASME rating class as relevant piping.

A Spacer / Spade is required for low-temperature piping with operating temperatures below 0^{o}C (cold insulated e.g. LNG plants). This is to avoid icing problems, when the operating temperature is below the dew point of air, with excessive condensation and corrosion at high humid location.

All process equipment nozzles provided with either a spectacle blind or spacer should have appropriate valving to allow for the spectacle blinds to be swung or spades to be installed. This shall not apply for:

i. Dead-ended instrument connections;
ii. Nozzles in non-hydrocarbon service where it is established that a hazardous condition due to flammability, toxicity, pressure or temperature cannot exist;
iii. Where removable spool pieces have been provided for equipment withdrawal (e.g. heat exchangers and pumps).

Isolations and piping provided at low points shall have suitable material piping selection for stagnant dead leg conditions. This is mainly experienced in low point drains and blowdown non-flowing connections. This is to avoid potential corrosion and passing of hazardous, flammable or combustible material across the blinds/spec blinds.

9.6.2 Positive Isolation with Single Block & Bleed

This arrangement consists of a single block valve with a bleed valve.

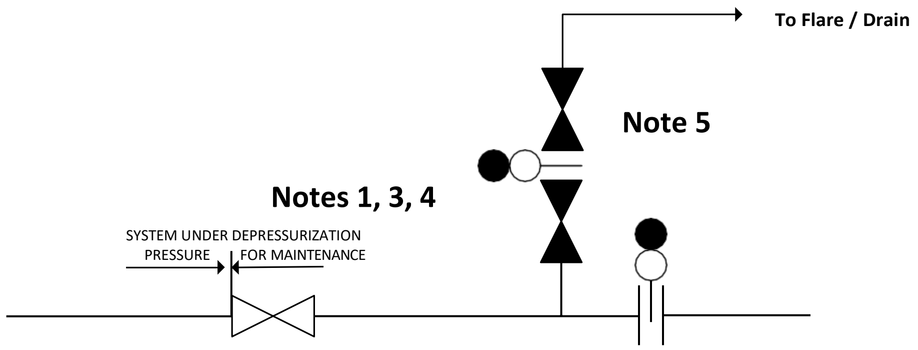

Figure 9.1- Single Block & Bleed Isolation

Note 1: Valve types shall be based on the project specific requirement. Refer to Table 9.1 for the isolation requirements which shall also be applicable to the bleeds. Bleed can be either drain or vent depending on the fluid type.
Note 2: These sketches are not a replacement for P&ID details and only address isolation.
Note 3: The bleed shall be located between the valve and blind to allow check of isolation valve passing, post positive isolation before reversing blind after end of maintenance activities.
Note 4: The number of blinds / second bleed isolation valve could be common among a number of such connections nearby in order to optimize the number of bleed valves/blinds.
Note 5: Requirement for the second bleed valve is to be evaluated on a case by case basis by Group Companies depending upon their service conditions and adopted design.

9.6.3 Positive isolation –with Double Block & Bleed

This arrangement comprises of two block valves with intermediate bleed valves. Refer to Figures 9.3 (a) (b)

9.7 Bleeds configuration & Routing

All bleeds in hydrocarbon / hazardous service shall be routed to a closed system i.e. vents shall be routed to flare system and drains shall be routed to a closed drain system. No local venting and bleed shall be allowed for hydrocarbon and toxic services. Bleeds for PSV inlet and drain connections are not required to be connected to the closed system (single valve blinded).

For remote facilities where a closed system is not available, bleeds shall be routed to an atmospheric safe location with required checks of dispersion.

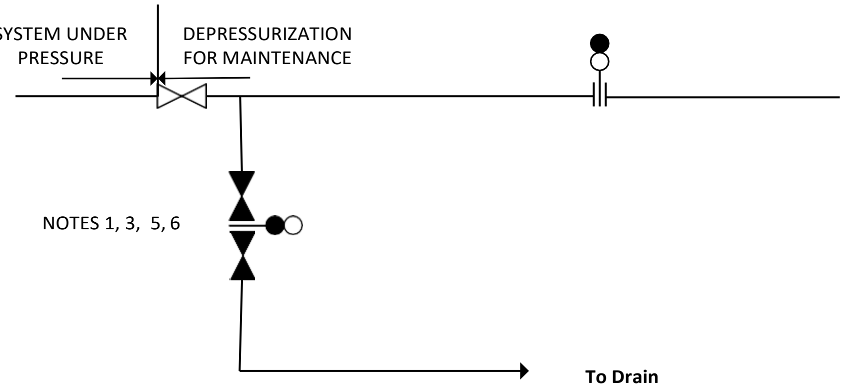

Figure 9.2 (a) Liquid Bleeds-SBB

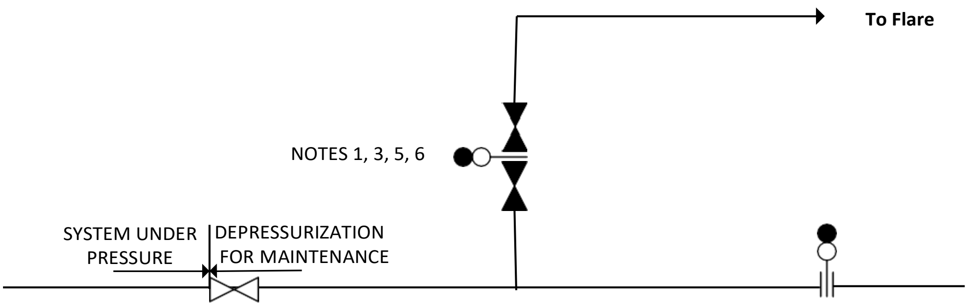

Figure 9.2 (b) Vapour Bleeds-SBB

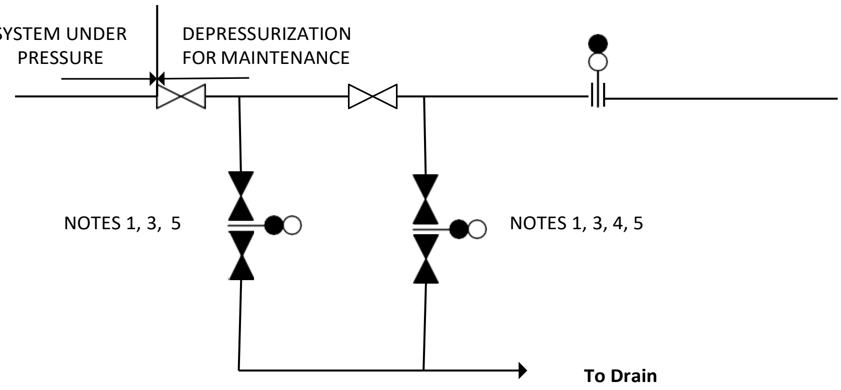

Figure 9.3 (a) Liquid Bleeds-DBB

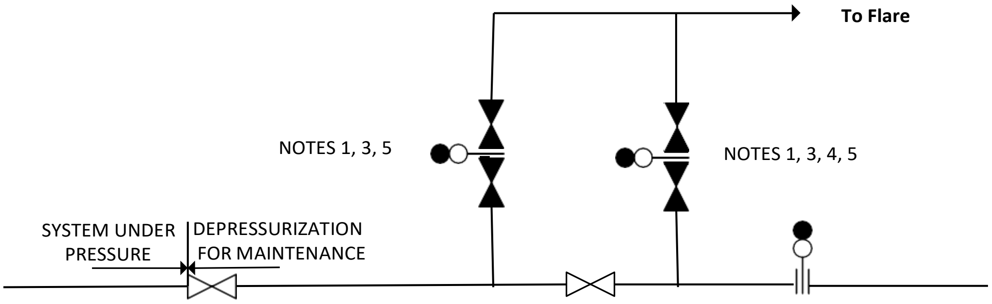

Figure 9.3 (b) Vapour Bleeds -DBB

Note 1: Valve type shall be based on the project specific requirement. Refer to Table 9.1 for the isolation requirements which shall also be applicable to the bleeds. Bleed can be either drain or vent depending on the fluid type
Note 2: These sketches are not a replacement for P&ID details and only address isolation
Note 3: Provide spectacle blinds in between the bleed valves, this blind shall be kept in closed position if they are connected to closed drain system and shall be preferably in open position if this bleed is connected to flare system.
Note 4: This bleed connection may be eliminated for small size pipes (up to 10''), and is required for larger pipes (more than 10''). Wherever this bleed is not provided, spectacle blinds shall be flanged to flange to the second valve, thereby eliminating the in-between spool.
Note 5: The number of blinds / second bleed isolation valve could be common among a number of such connections nearby in order to optimize the number of bleed valves/blinds.
Note 6: Requirement for the second bleed valve is to be evaluated on a case by case basis by Group Companies depending upon their service conditions and adopted design.

9.7.1 Valve Type Selection

The isolation valve types shown in sketches throughout this document are typical. The actual valve types selected will be based on the project specific philosophy.

The following shall not be used for equipment isolation:

i. Check Valves
ii. PSV's
iii. Control Valves
iv. Globe Valves
v. SDV (in SBB arrangement)

9.7.2 Shutdown Valves

SDVs can be used for isolation providing the following criteria are satisfied:

SDV is part of a DBB arrangement provided that SDV is located towards the depressurized end.

SDV is fail closed type.

Valve is not required to be serviced at the same time when it is required to be used as part of DBB arrangement for isolation (typically SDVs don't have upstream/downstream isolation valves for maintenance isolation purposes. However, this shall be evaluated on a case by case basis.)

SDV shall be located as close as possible to the other isolation valve.

In general, SDVs should not be bypassed. If a bypass around an SDV is unavoidable, the following are required:

- The bypass line should include an SDV;
- The bypass SDV is actuated in parallel with the primary SDV.

9.8 Isolation of Systems and Equipment for Maintenance

Below sections detail out sketches for various types of systems and equipment following above principles detailed in Section 9.6. In case of any mismatch, principles as spelt out in Section 9.6 govern.

9.8.1 Trains and Battery Limits

Battery limit (BL) should be defined based on plot plan considerations. Each unit or processing area should have a distinct battery limit. Isolation shall be provided on all process and utility lines crossing into or out of any process unit/area.

Isolation requirements addressed in Sections 9.6.2 and 9.6.3 shall be applicable to battery limit isolations with the exception that all battery limit isolation valves shall be manual.

A train is expected to be taken offline with train isolation valves for maintenance as a full section. For maintenance on equipment within the running train, valve and positive isolation shall be provided for the spared equipment for safe changeover.

Maintenance of equipment or instrument is achieved after system shutdown and depressurisation. No maintenance isolation between equipment within the package is envisaged. However, if within a package certain equipment are spared (for example, 2x100% pumps or filters), then the equipment will be provided with isolation as per the equipment isolation philosophy considering spare equipment. In general, necessary essential isolation shall be provided for spare equipment.

Typically isolation valves on the flare headers shall be avoided. However, in instances where this is not practical (such as systems having spare flares, number of unit flare headers connected to a common flare system etc), the isolation valves shall be locked open and shall be installed in a way that no blockage can occur in the relief path.

9.8.2 Vessel Isolation

Every nozzle, except connections to atmosphere (e.g. local vents, drains and utility connections) on major process vessels shall be provided with positive isolation (i.e. removable spool, spade...etc.) to enable hydrostatic testing and personnel entry.

Where inlet or outlet piping is arranged as a manifold, such as in the case of connection to more than one nozzle on the vessel, a single positive isolation mean located at the manifold isolation valve is acceptable. This is in preference to positively isolating each vessel nozzle, provided that the method of isolation is clearly visible from the vessel.

All process vessels containing hydrocarbons shall be provided with a block valve and blind flange for venting direct to atmosphere, in addition to a valve connection to the flare header. This connection is for use when the vessel is open for maintenance and is kept closed and blinded during normal operation.

All process vessels containing hydrocarbons shall be provided with a utility connection for general vessel flushing and also to displace process gases with nitrogen for inerting.

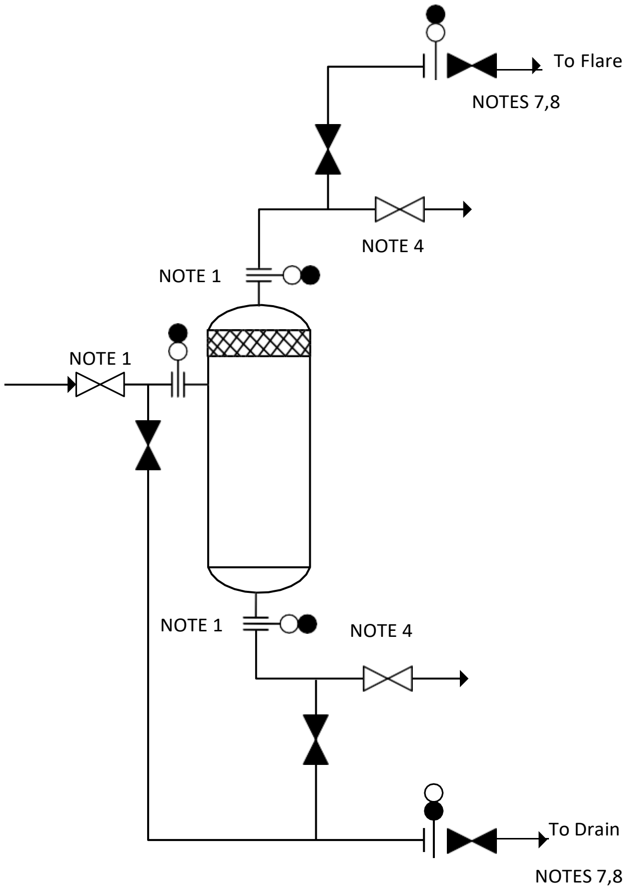

Figure 9.4 – Vessel Isolation (Single Block & Bleed)

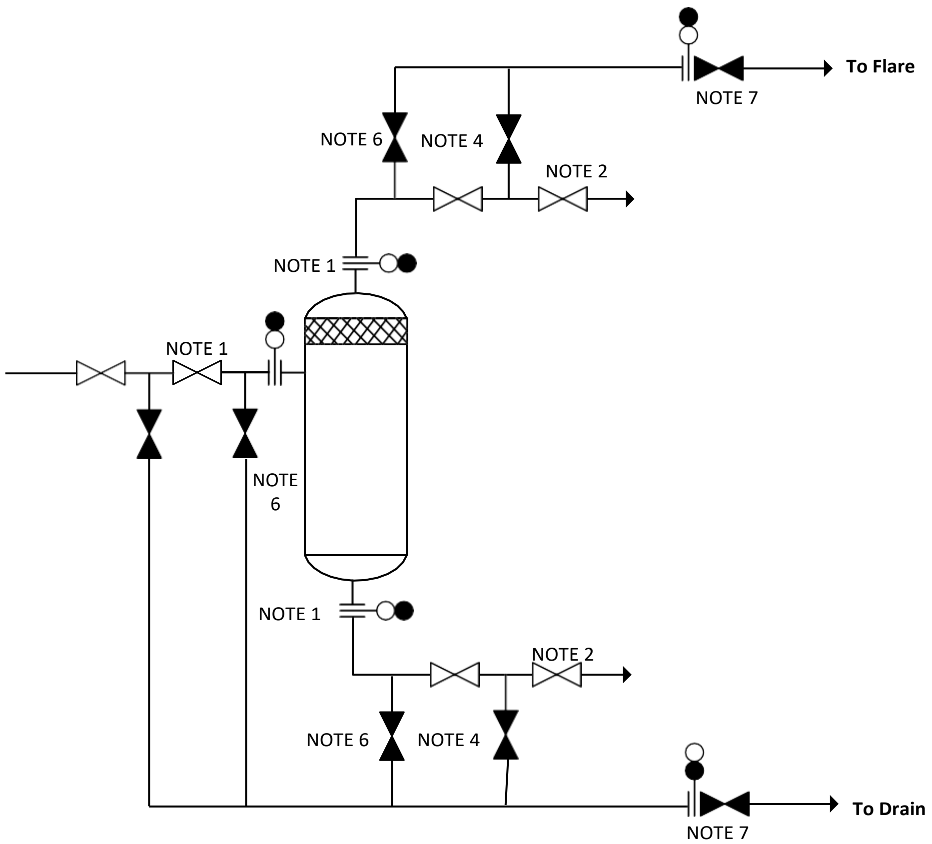

Figure 9.5–Vessel Isolation (Double Block & Bleed)

Note 1: Positive isolation is achieved by using Removable spool, Spectacle Blind, Spacer based on piping design consideration. In case the isolation valve cannot be located close to vessel nozzles, the positive isolation may be achieved by Removal Spool to reduce the inventory loss.

Note 2: Individual vessel isolation for maintenance may not be required where complete shutdown of train/unit is required for maintenance. In such cases unit/train isolation may be achieved (SBB or DBB) as per Table 9.1.

Note 3: Special consideration should be given to the installation of spool pieces between large bore valves (definition of large bore will be project specific), in order to facilitate safe removal of equipment.

Note 4: Valve types shall be based on the project specific requirement. Refer to Table 9.1 for the isolation requirements which shall also be applicable to the bleeds. Bleed can be either drain or vent depending on the fluid type

Note 5: These sketches are not a replacement for P&ID details and only address isolation

Note 6: This bleed connection may be eliminated for small size pipes (up to 10''), and is required for larger pipes (more than 10''). Wherever this bleed is not provided, spectacle blinds shall be flanged to flange to the second valve, thereby eliminating the in-between spool.

Note 7: The number of blinds / second bleed isolation valve could be common among a number of such connections nearby in order to optimize the number of bleed valves/blinds.

Note 8: Requirement for the second bleed valve is to be evaluated on a case by case basis by Group Companies depending upon their service conditions and adopted design.

9.8.3 Pump Isolation

Pumps A/B (1 duty and 1 standby) will be equipped with block valves at the suction (upstream of the strainer if applicable) and discharge side. Pump suction isolation valve shall have the same pressure rating as the discharge system starting from the inlet isolation valve / DBB isolation. A block valve at the pump discharge shall be provided to allow manual operation if required during start-up. In case of suction vessel operating under vacuum, the vent connection on the pump shall be permanently connected to the vapour space of the suction vessel to allow positive filling of the pump without opening the discharge valve.

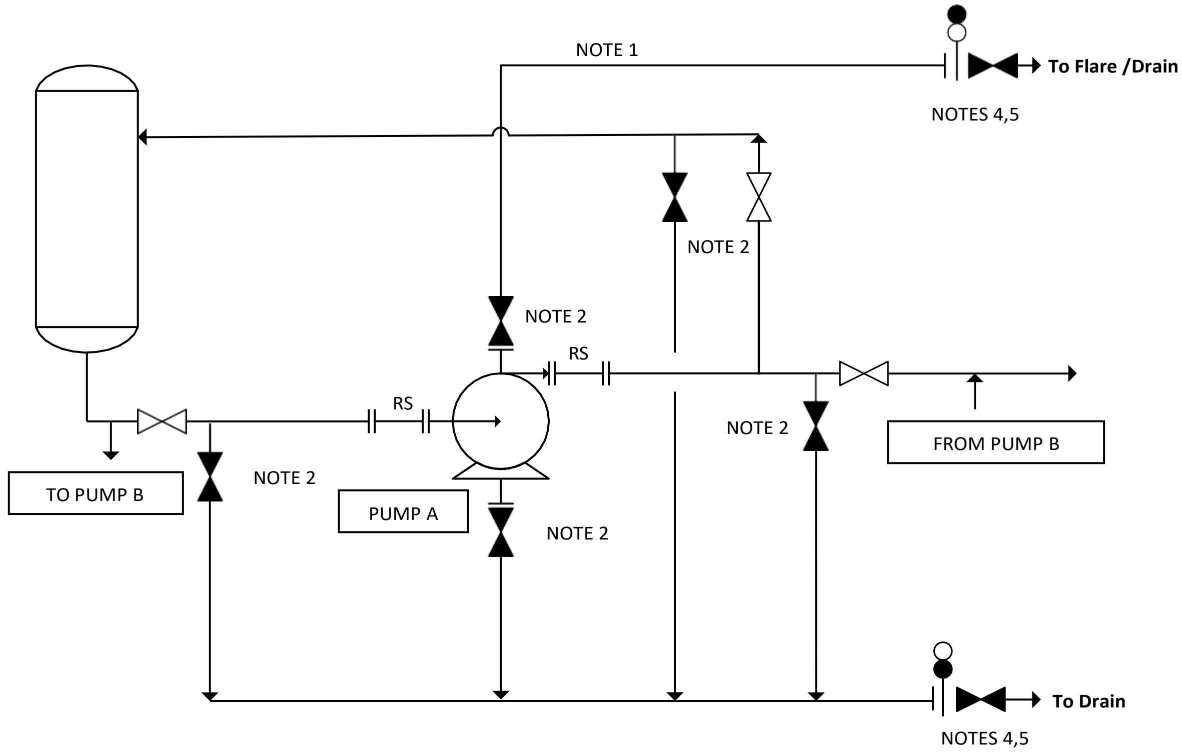

Figure 9.6– Pump Single Block & Bleed Isolation

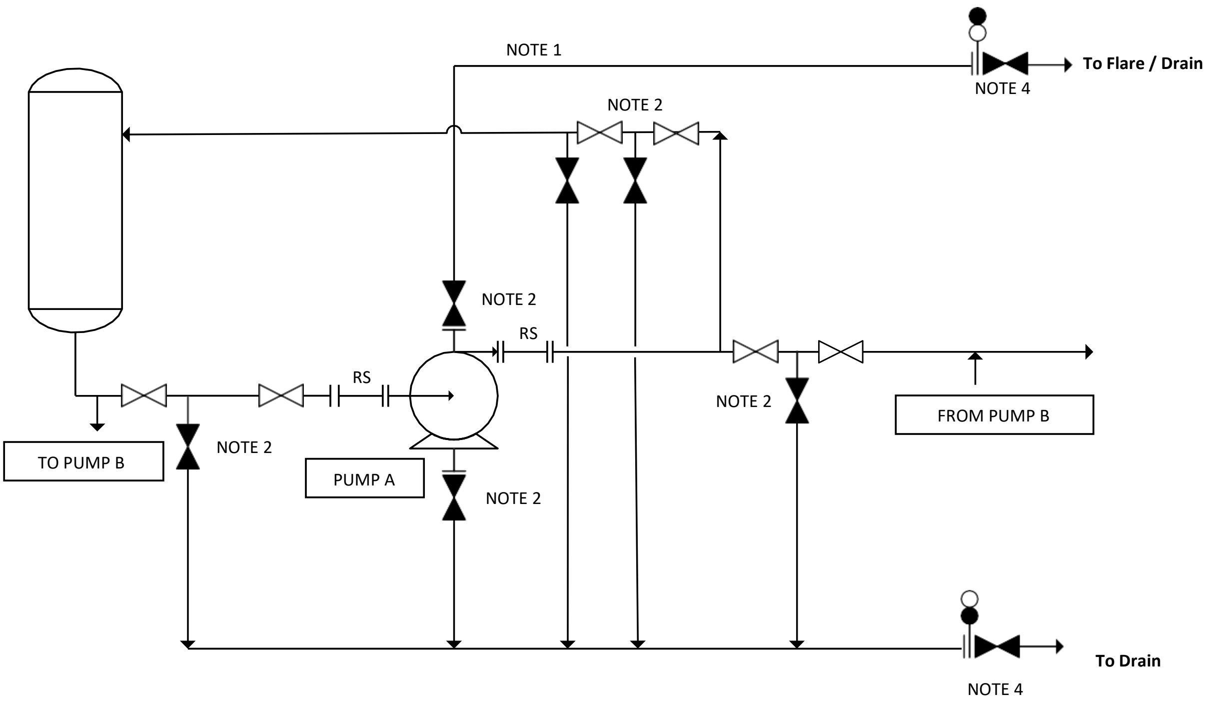

Figure 9.7 – Pump Double Block & Bleed Isolation [PSR]

Note 1: Pump casing vent.

Note 2: Valve types shall be based on the project specific requirement. Refer to Table 9.1 for the isolation requirements which shall also be applicable to the bleeds.

Note 3: These sketches are not replacement of P&ID details and only address isolation requirements.

Note 4: The number of blinds / second bleed isolation valve could be common among a number of such connections nearby in order to optimize the number of bleed valves/blinds.

Note 5: Requirement for the second bleed valve is to be evaluated on a case by case basis by Group Companies depending upon their service conditions and adopted design.

Removable spool pieces will be provided for maintenance purposes, on the suction and discharge nozzles of pumps. For non-hazardous service pump drains, and vents shall be discharged to atmosphere.

9.8.4 Compressor Isolation

Removable spool pieces will be fitted for maintenance purposes, on the suction and discharge nozzles of all compressor stages. Facilities will be provided to isolate individual compressor trains.

Block and bleed valves shall be provided for compressor casing drain, vent and utility connections. Isolation should be as close as possible to the compressor to minimise the clean-up requirements.

Where a piping specification break occurs at a compressor, consideration shall be given to upstream piping spec and compressor settle out pressure in determining the suction side isolation limits (SBB or DBB – refer to Table 9.1), although pressure rating specification break shall be located at the upstream flange of the first suction side isolation valve.

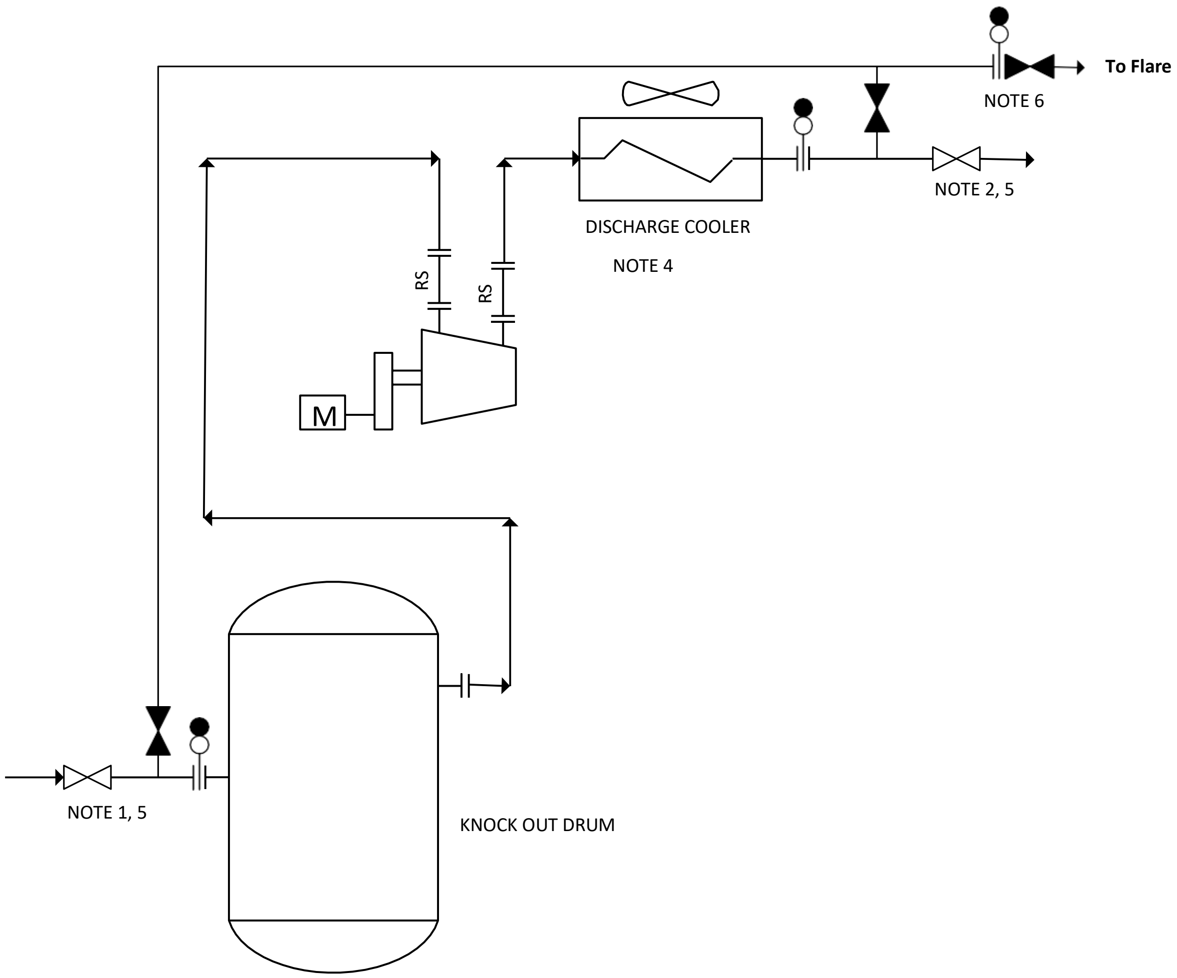

Figure 9.8 – Compressor Single Block and Bleed Isolation

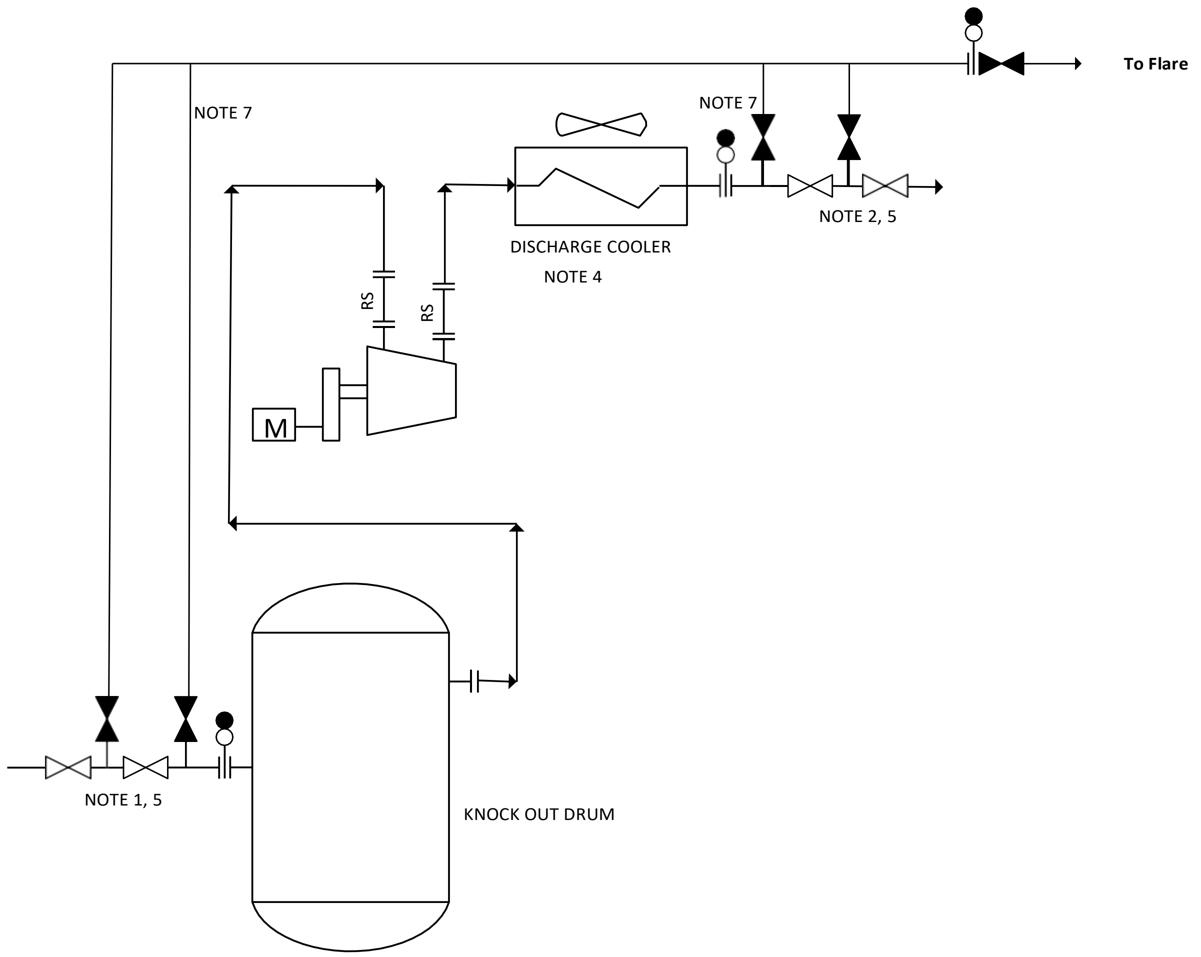

Figure 9.9 – Compressor Double Block and Bleed Isolation [PSR]

Note 1: Suction isolation valves to be placed upstream of the compressor suction knock-out drum
Note 2: Discharge isolation valves to be placed downstream of the discharge cooler
Note 3: These sketches are not a replacement for P&ID details and only address isolation
Note 4: Refer to Section 9.8.5 for air cooler bays isolation
Note 5: Valve types shall be based on the project specific requirement. Refer to Table 9.1 for the isolation requirements which shall also be applicable to the bleeds.
Note 6: Requirement for the second bleed valve is to be evaluated on a case by case basis by Group Companies depending upon their service conditions and adopted design.
Note 7: This bleed connection may be eliminated for small size pipes (up to 10''), and is required for larger pipes (more than 10''). Wherever this bleed is not provided, spectacle blinds shall be flanged to flange to the second valve, thereby eliminating the in-between spool.

9.8.5 Heat Exchangers Isolation

(a) Shell & Tube Exchanger

Isolation valves for heat exchangers shall be provided on the inlet and outlet lines of heat exchangers, if the exchanger can be isolated for maintenance with the plant still in operation.

Bypasses for heat exchangers should be provided if the exchanger can be isolated for maintenance with the plant still in operation. However bypasses shall not be provided for final coolers (product to storage exchangers).

Removable spools will be provided between the exchanger nozzles and the isolating valve (applicable to tube side). This spool piece will be removed, and the end blanked, to provide positive isolation for maintenance.

All Shell and Tube Exchangers, including vertical units shall be provided with vents and drains allowing complete draining and venting of both shell and tube sides.

Isolation valves for Reboilers shall only be supplied if a dedicated PSV is installed.

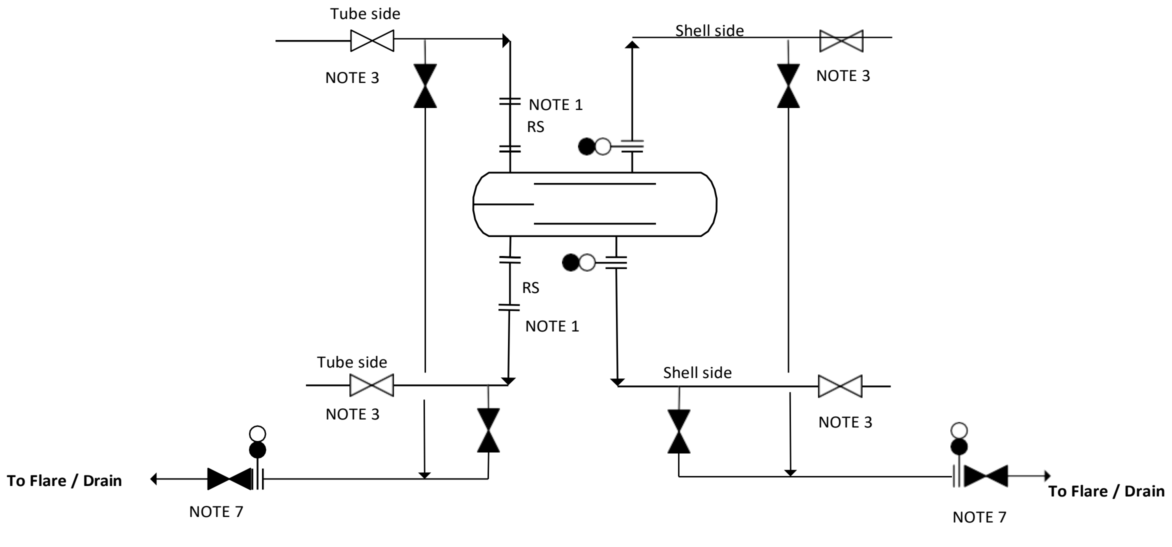

Figure 9.10 – Heat Exchanger Isolation- Single Block and Bleed Isolation on both Tube Side & Shell Side

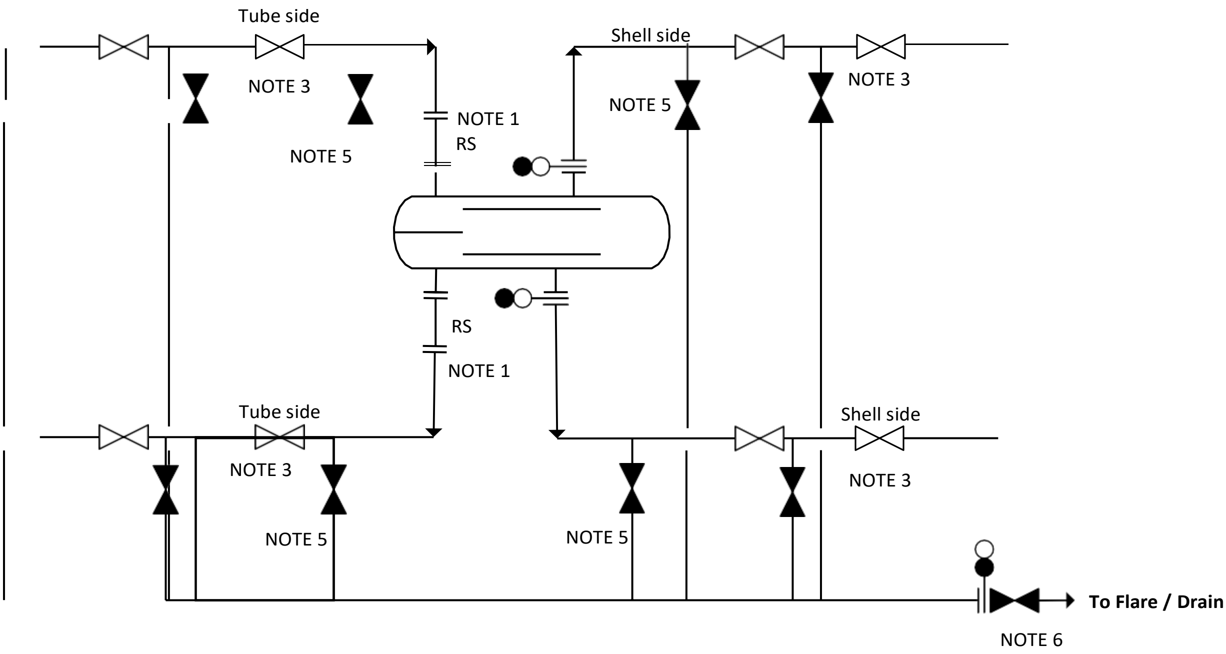

Figure 9.11 – Heat Exchanger Isolation- Double Block and Bleed Isolation on both Tube Side & Shell Side [PSR]

Note 1: Positive isolation on tube side can be achieved by using Removable spool, Spectacle Blind or Spacer based on Maintenance (cleaning) requirement and tube type/configuration

Note 2: Special consideration should be given to the installation of spool pieces between large bore valves (definition of large bore will be project specific), in order to facilitate safe removal of equipment.

Note 3: Valve types shall be based on the project specific requirement. Refer to Table 9.1 for the isolation requirements which shall also be applicable to the bleeds. Bleed can be either drain or vent depending on the fluid type.

Note 4: These sketches are not a replacement for P&ID details and only address isolation.

Note 5: This bleed connection may be eliminated for small size pipes (up to 10''), and is required for larger pipes (more than 10''). Wherever this bleed is not provided, spectacle blinds shall be flanged to flange to the second valve, thereby eliminating the in-between spool.

Note 6: Provide spectacle blinds in between the bleed valves, this blind shall be kept in closed position if they are connected to closed drain system and shall be preferably in open position if this bleed is connected to flare system.

Note 7: Requirement for the second bleed valve is to be evaluated on a case by case basis by Group Companies depending upon their service conditions and adopted design.

(b) Air Cooler

For air coolers bays/tube bundle isolation, the following shall be followed in order to optimize the number of valves as well as create ease of operation and maintenance:

i. Air cooler with less than or equal to 4 bays and above shall have isolation valves and spectacle blinds or removal spools (up to 4 bays) at the inlet and outlet of each bay along with appropriate vents and drains. In some cases, one bay can have more than one tube bundle which results in the requirement of removable spool/spectacle blind at the inlet/outlet of every tube bundle.
ii. Air cooled heat exchanger having between 5 and 15 bays should have isolation valve and spectacle blind for each 20% of the bays at the inlet and outlet of each bay along-with appropriate vents and drains.
iii. Air Cooled heat exchangers having 16 or more bays will have isolation valves and spectacle blinds for each 25% of bays at the inlet and outlet of each bay along- with appropriate vents and drains.

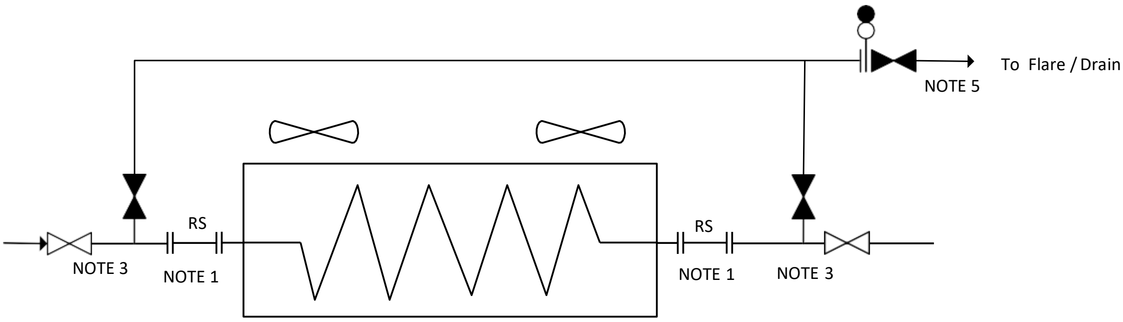

Figure 9.12 – Individual Bay Isolation (up to 4 bays) Single Block and Bleed Isolation

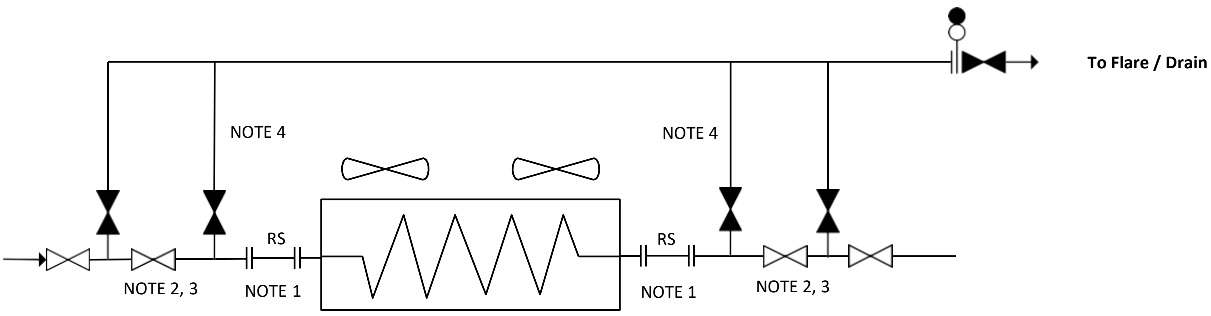

Figure 9.13 – Individual Bay Isolation (up to 4 bays) Double Block and Bleed Isolation [PSR]-

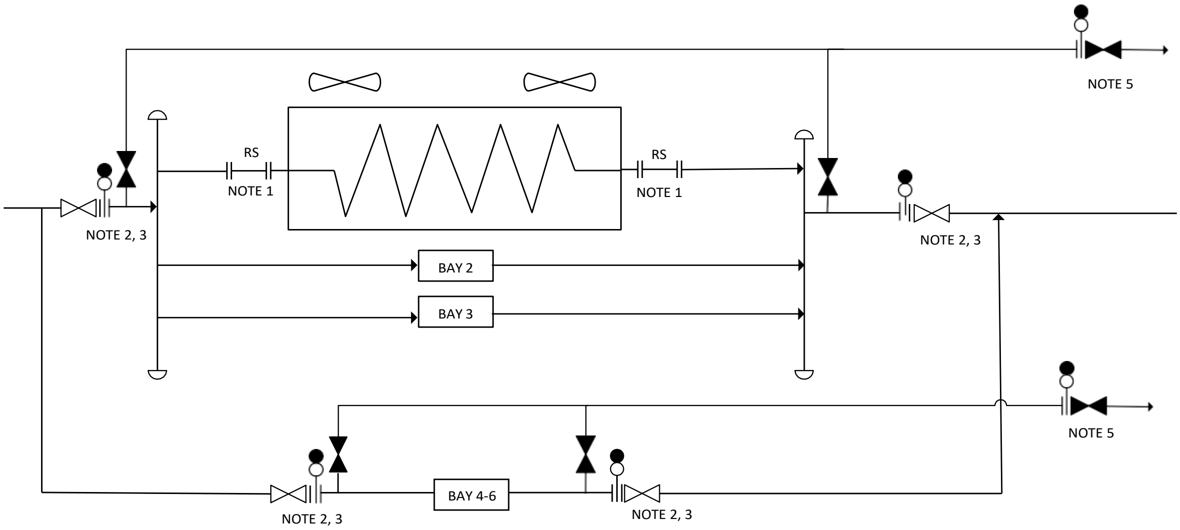

Figure 9.14 - Grouped Single Block and Bleed Isolation Arrangement for (5-15 bays configuration)

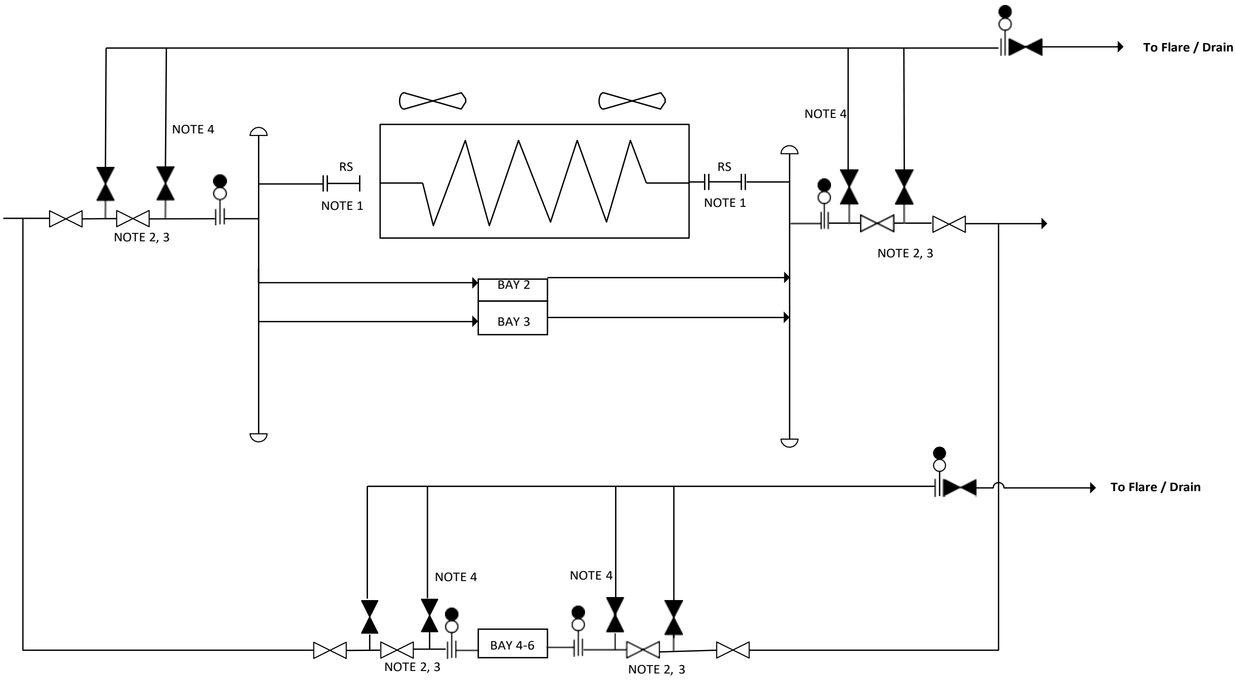

Figure 9.15 - Grouped Double Block and Bleed Isolation Arrangement for (5-15 bays) more [PSR]

Note 1: Positive isolation on tube side can be achieved by using Removable spool, Spectacle Blind or Spacer based on Maintenance (cleaning) requirement and tube type/configuration

Note 2: Special consideration should be given to the installation of spool pieces between large bore valves (definition of large bore will be project specific), in order to facilitate safe removal of equipment.
Note 3: Valve types shall be based on the project specific requirement. Refer to Table 9.1 for the isolation requirements which shall also be applicable to the bleeds. Bleed can be either drain or vent depending on the fluid type.
Note 3: These sketches are not a replacement for P&ID details and only address isolation
Note 4: This bleed connection may be eliminated for small size pipes (up to 10''), and is required for larger pipes (more than 10''). Wherever this bleed is not provided, spectacle blinds shall be flanged to flange to the second valve, thereby eliminating the in-between spool.
Note 5: Requirement for the second bleed valve is to be evaluated on a case by case basis by Group Companies depending upon their service conditions and adopted design.

Valves can be considered in corrosive and fouling services for maintenance of the individual tube bundles with the plant still in operation. In most case permanent spectacle blinds or spacers are installed at the nozzles if required.

Administrative controls shall be used to ensure a path to relief is available at all times (e.g., LO valves).

(c) Plate & Frame Exchanger

Plate and frame heat exchangers generally have the same isolation requirements as shell and tube heat exchangers, due to the requirements for cleaning and other maintenance.

Vents, drains and purge points, should be provided to permit safe depressurisation, draining and purging prior to maintenance.

9.8.6 Pig Trap Isolation

A mechanical key exchange type interlock shall be provided on the pig trap inlet valve, kicker line valve, vent valves, drain valve and pig trap door to prevent opening of the trap under pressure and avoid release of hazardous fluids. All piggable lines shall have Full Bore (FB) valves. Each pig trap will have a tell-tale valve, located upstream of manual drain valve. The purpose of this valve is to ensure that pig traps are drained completely before opening the pig trap door. End closures will be supplied by approved manufacturers and will include a pressure warning device.

9.8.7 Instrument isolation

Isolation valves for trip functions shall be LO (Locked Open). Single and Double block isolation arrangement is to be followed in accordance with Table 9.1. For isolation of pressure instruments, integral double block is recommended. If this is not possible, normal double block and bleed can be used. Instrument vents and drains shall be 2" NPS. In principal, drains and vents in Hydrocarbon service are to be connected to a closed drain system, however where closed drain/flare systems are not available proper dispersion analysis shall be performed to define the location of safe venting. Exceptions, if required, shall be approved by COMPANY.

It is recommended that all hazardous services vent to flare and drain to a closed drain system, and that all non-hazardous services vent to atmosphere and drain to an open or closed drain system depending on the pressure rating. All online instruments where instruments contain large inventories of process fluid e.g. level transmitters floating type or where frequent blow down of instrument impulse lines is envisaged, vents and drain shall be minimum size 2" NPS.

(a) Flow Orifices and Pressure Transmitters

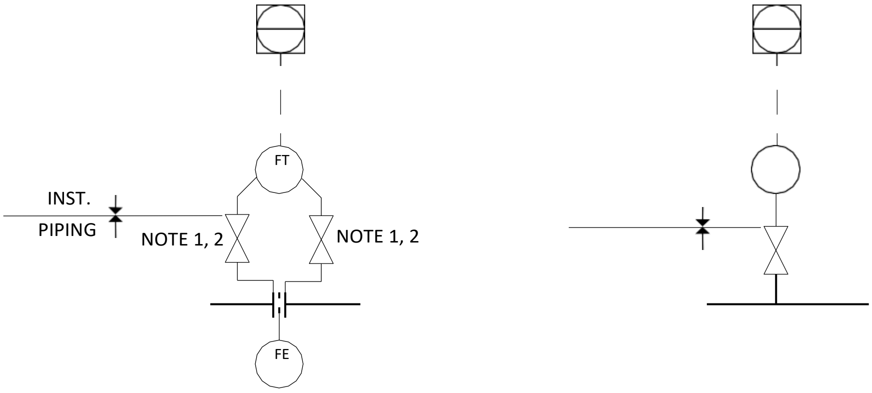

Figure 9.16 Flow Orifice and Pressure Transmitter Isolation Arrangement for Single Block and Bleed

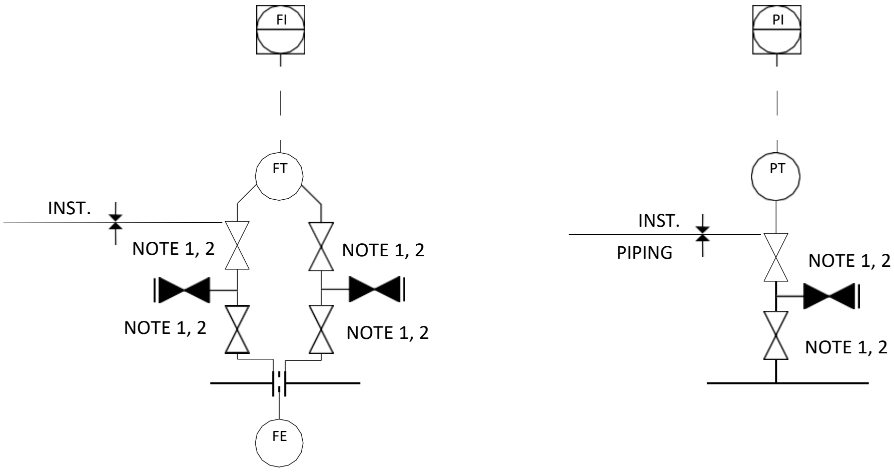

Figure 9.17 Flow Orifice and Pressure Transmitter isolation arrangement for Double Block and Bleed

Note 1: Valve types shall be based on the project specific requirement. Refer to Table 9.1 for the isolation requirements which shall also be applicable to the bleeds. Bleed can be either drain or vent depending on the fluid type.
Note 2: Isolation Valves for trip functions shall be Locked Open (LO).
Note 3: These sketches are not a replacement for P&ID details and only address isolation requirements.

(b) Level Instruments

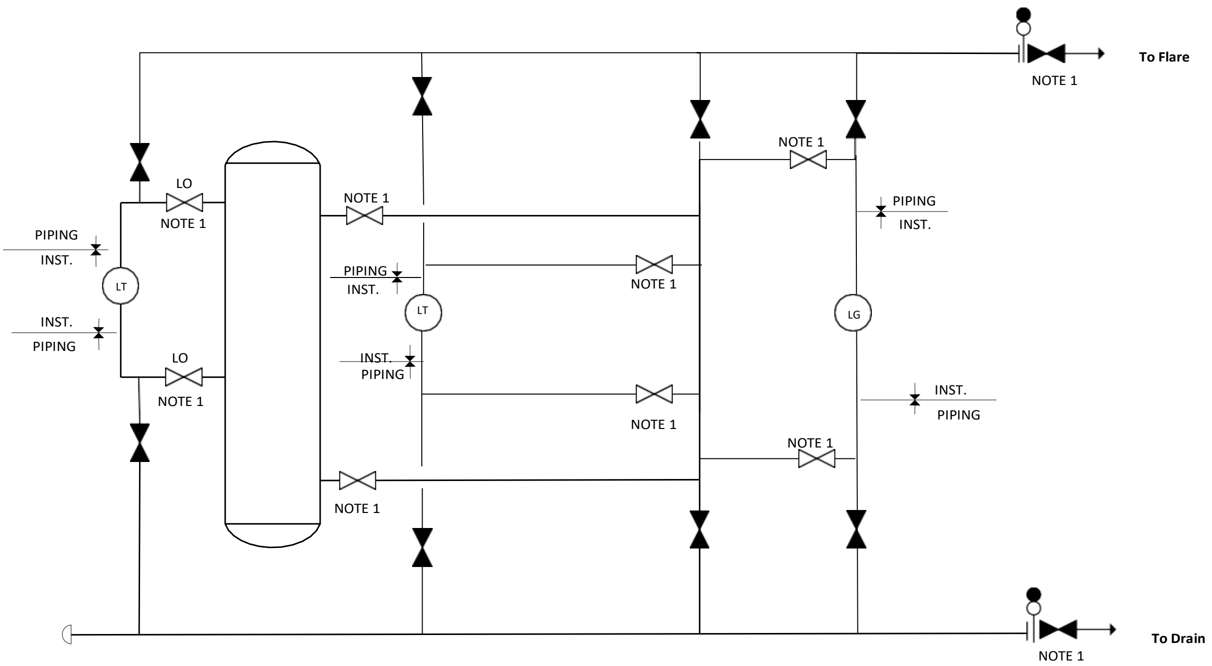

Figure 9.18 Level instrument Single Block and Bleed Isolation arrangement

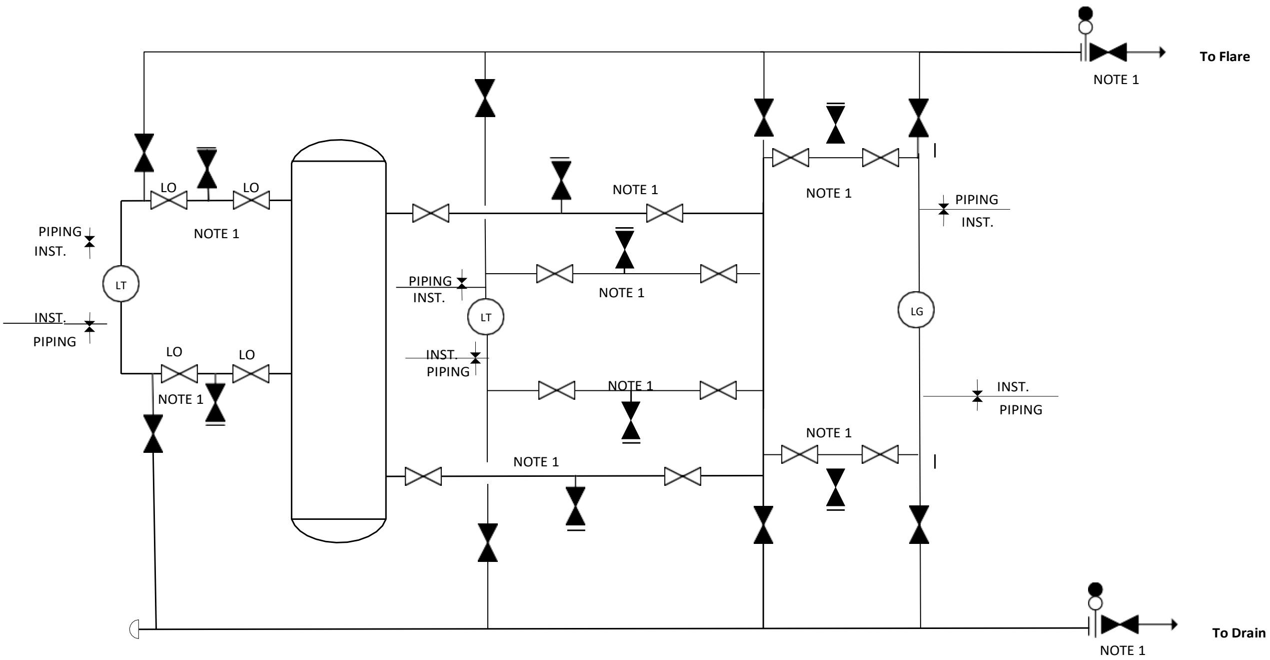

Figure 9.19 Level instrument Double Block and Bleed Isolation arrangement [PSR]

Note 1: Valve types shall be based on the project specific requirement. Refer to Table 9.1 for the isolation requirements which shall also be applicable to the bleeds. Bleed can be either drain or vent depending on the fluid type.
Note 2: These sketches are not a replacement for P&ID details and only address isolation

All level instruments and level gauges having spectacle blind preferably in open position for ease of operation (being a frequent operation and where very small volumes require to be flushed). The position of the spectacle blinds may be finalized based on the individual Company operating practices and risk assessment.

Instrument vents and drains shall be 2" NPS minimum.

In principal, drain and vents of Hydrocarbon service to be connected to closed system, however where closed drain/flare systems are not available, a proper dispersion shall be performed to define the location of safe venting. Exceptions, if required, shall be approved by COMPANY.

It is recommended that all hazardous services vent to flare and drain to a closed drain system, and all non-hazardous systems vent to atmosphere and drain to an open drain system. Refer to Section 9.7 for the bleed configurations which shall follow Table 9.1.

(c) Control Valves

Where parallel control valves are provided, due to the severity of duty and mandated availability, both the control valves shall be provided with isolation valves and drain/vent valves.

Where it is considered necessary to bypass a control valve, bypass arrangements around the control valve shall be installed to permit maintenance of the control valve, without the need to shut down the process unit. For operation/ machinery critical control valves such as anti-surge valve and turbine speed control, bypass valves shall not be provided [PSR].

Such bypasses will normally contain a manually operated globe valve, however, the type can be different based on the service requirements.

It is recommended for all hazardous services to vent to flare and drain to a closed drain system, and all non-hazardous systems vent to atmosphere. However, dispersion analysis to be carried out in order to determine the vent location.

Figures 9.23a/b and 9.24a/b are representation of FO & FC/FL mode of failure. For FO mode of failure it is recommended to have a single vent/drain either upstream or downstream of the Control Valve.

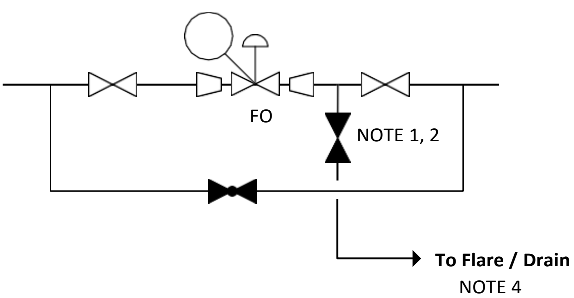

Figure 9.20 (a): Single Block and Bleed Arrangement for FO Control Valves.

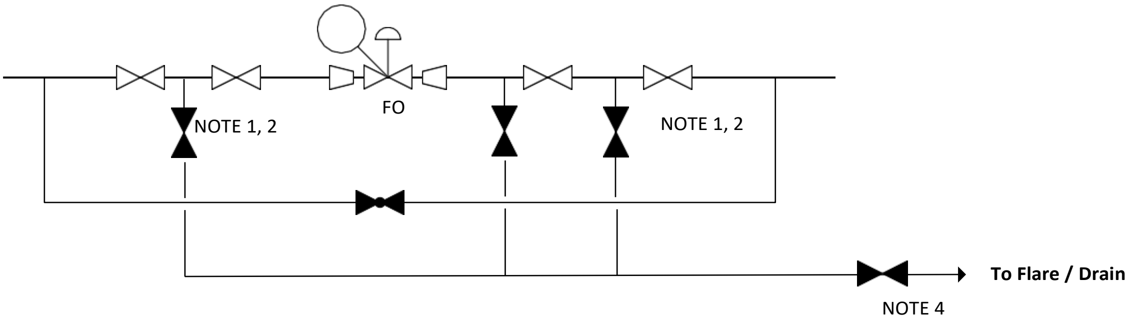

Figure 9.20 (b) Double Block and Bleed Arrangement for FO Control Valves.

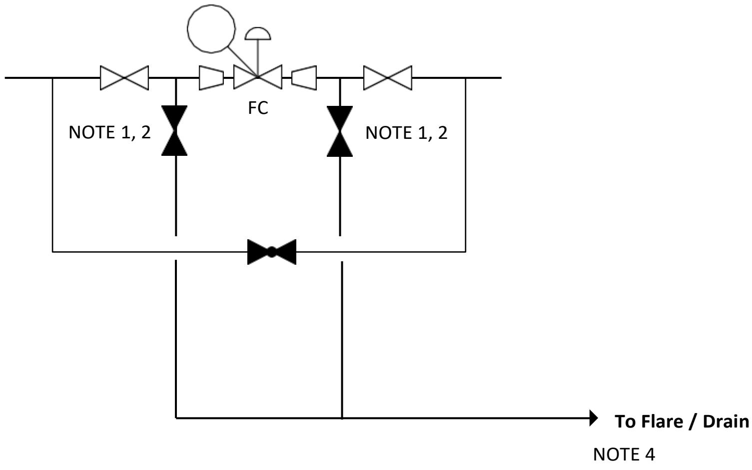

Figure 9.21 (a) Single Block and Bleed Arrangement for FC/FL Control Valves.

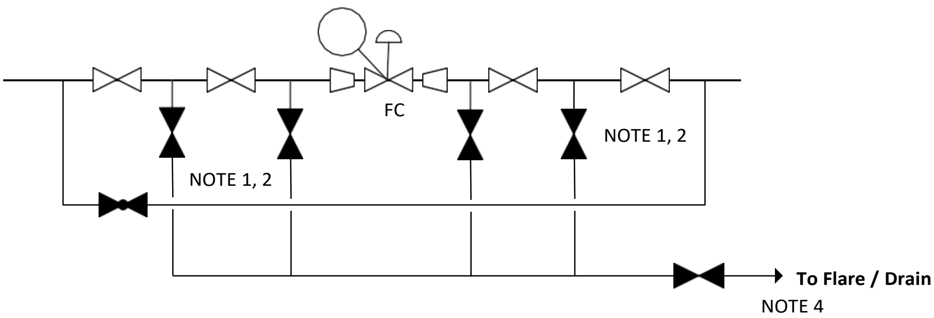

Figure 9.21 (b) Double Block and Bleed Arrangement for FC/FL Control Valves.

Note 1: Vents are shown in case of gas service and drain are shown in case of liquid service for flashing service both vent & drains shall be provided.

Note 2:.Valve types shall be based on the project specific requirement. Refer to Table 9.1 for the isolation requirements which shall also be applicable to the bleeds.

Note 3: These sketches are not a replacement for P&ID details and only address isolation.

Note 4: Where the control valve is in hydrocarbon, toxic, sour or potentially harmful service, the vents and drains shall be connected to closed systems, e.g. flare or appropriate closed drain system.

9.8.8 Relief Valves

All isolation valves upstream / downstream of relief valve shall be full bore.

Relief valves with a spare shall be equipped with lockable isolation valves with bleed arrangement for both inlet and outlet lines. Duty inlet line PSV shall be interlocked open (ILO) and spare line PSV upstream isolation valves shall be interlocked closed (ILC) or mechanically interlocked, such that if one relief valve is isolated for maintenance, the other relief valve is ensured to be on line (key operated locking system) and such that the process is never isolated from relief path.

Mechanical key interlock shall be in place with a sequenced changeover between the online and the spare isolated PSV for PSV removal for maintenance utilizing the interlock keys for PSV changeover. This is in order to ensure that under no circumstance, the equipment is isolated from relief path and is always protected.

Locked open block valve shall be provided downstream of a relief valve discharging into flare header.

A bleed shall be provided between the PSV and the outlet isolation valve to bleed any trapped fluid prior to PSV removal as per API 520 part II [1].

Isolation valves shall be avoided upstream of relief valve where a spare valve is not provided. Exceptions have to be justified individually. Such relief valves will be isolated from upstream vessels/piping by means of removable spool piece i.e. PSV's on pig traps don't have inlet isolation valve because pigging operation is intermittent.

Tail piping of all relief valves and blow-down lines from individually spared process systems shall be combined into a sub header with positive isolation, provided by locked open valves, from the main live flare header to facilitate the independent shutdown and maintenance of the systems where required (generally no spectacle blinds will be provided downstream of PSVs, however a spectacle blind/spacer may be provided to separate a sub-system header from the main flare header for taking sections of the flare piping out of operation).

9.8.9 Mechanical Interlocks.

Mechanical Interlocks of valves at inlet and outlet of PSV's are recommended, however LO/LC AND CSO/CSC can be used in line with API 520 Part II [1] provided that strict administrative controls are in place.

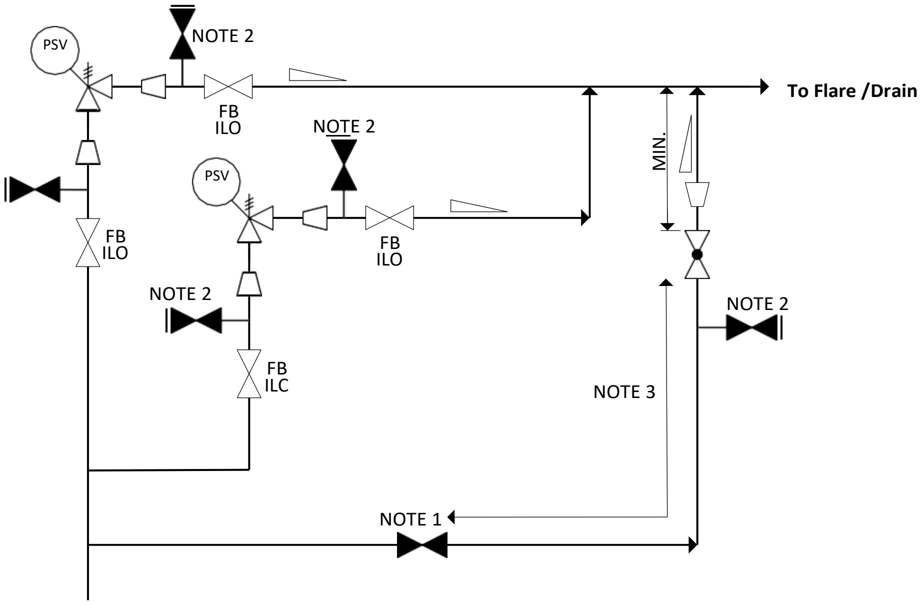

Figure 9.22 Single Block and Bleed Isolation for PSV's

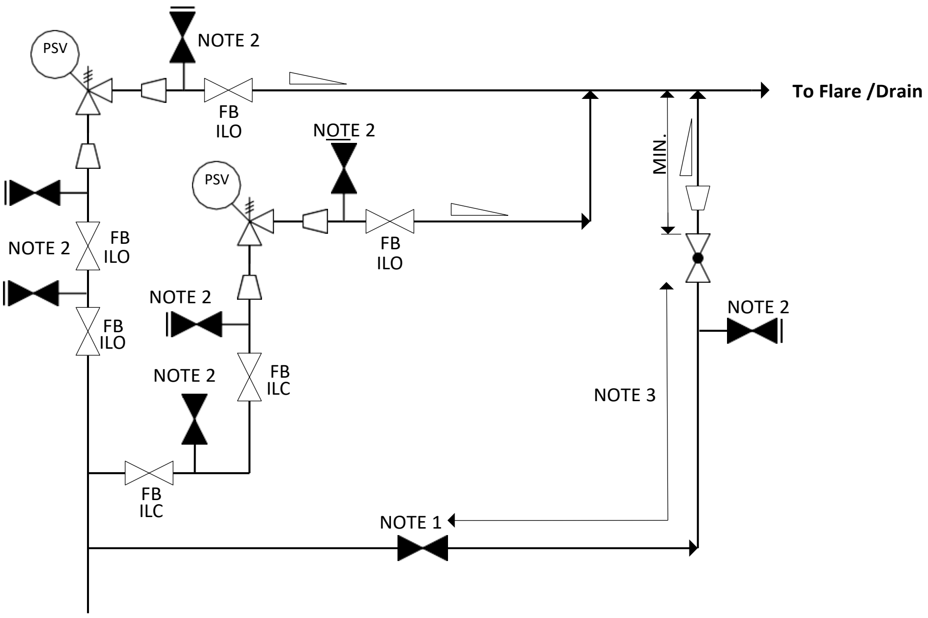

Figure 9.23 Double Block and Bleed Isolation for PSV's

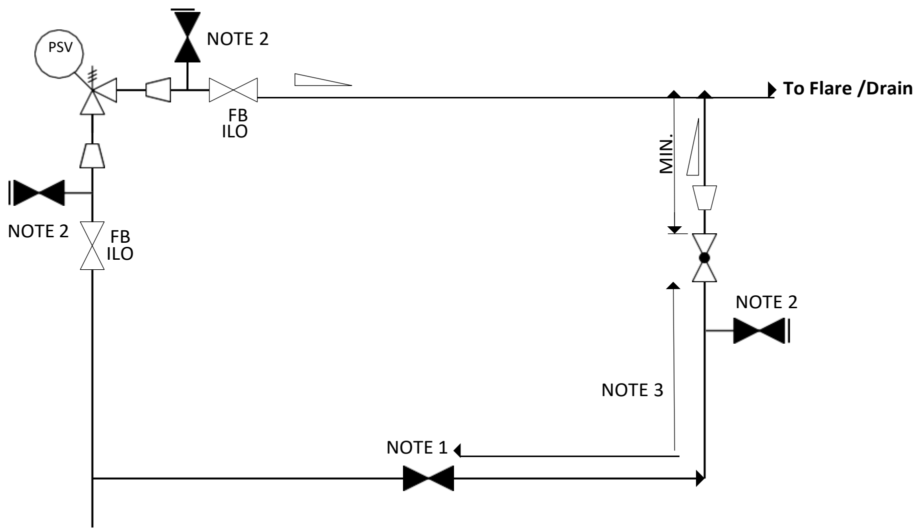

Figure 9.24 Single Block and Bleed Isolation for PSV's with no spare or thermal relief

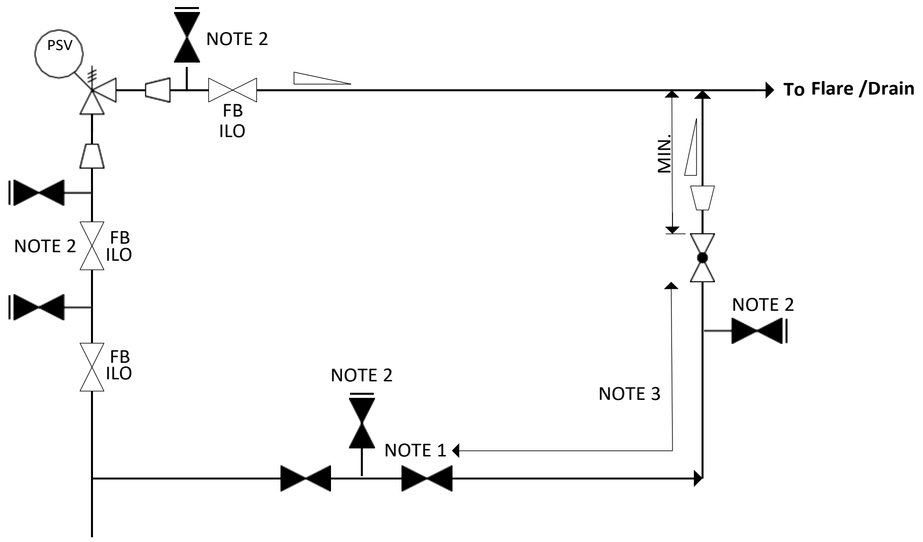

Figure 9.25 Double Block and Bleed Isolation for PSV's with no spare or Thermal Relief [PSR]

Note 1: NC or LC to be determined on Safety Risk Assessment
Note 2: Vent in case of gas service and drain in case of liquid service
Note 3: Min 1000 mm for cryogenic services and 600 mm for all other services
Note 4: Valve types shall be based on the project specific requirement. Refer to Table 9.1 for the isolation requirements which shall also be applicable to the bleeds..
Note 5: Relief Valve isolation valves to be FB (Full Bore).
Note 6: Valves to be ILO (interlocked Open) and any replacement of PSV shall be through permit-to-work system and after carrying out Safety Analysis.

Note 7: These sketches are not a replacement for P&ID details and only address isolation

9.8.10 Blowdown System Isolation

A locked open full bore isolation valve shall be provided upstream and downstream of the restriction orifice in the blowdown line to facilitate maintenance of the blowdown valve.

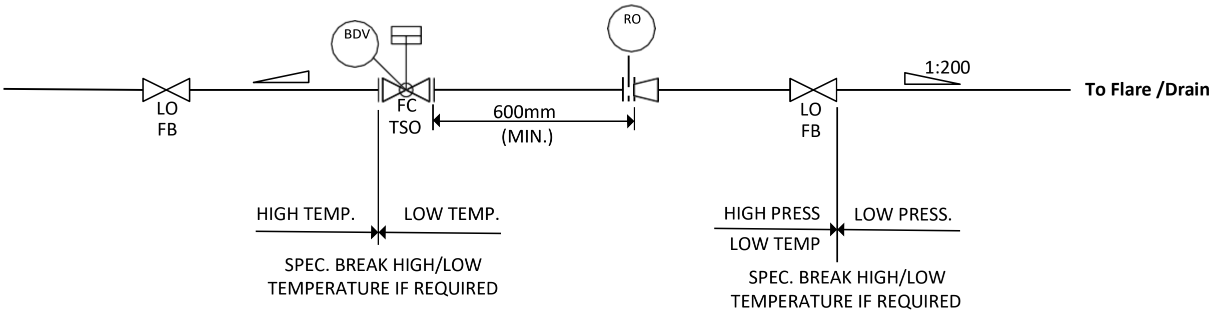

Figure 9.26 Isolation for Blowdown Systems

Note 1: Valve types shall be based on the project specific requirement. Refer to Table 9.1 for the isolation requirements which shall also be applicable to the bleeds.

Note 2: Blowdown valves should be in high pressure/low temperature specification

Isolation valve upstream of the blow down valve added to facilitate on line testing/maintenance of the BDV, avoiding depressurization of system, but there shall be strict administrative controls in place.

9.8.11 Package Isolation

A package is expected to be taken offline for maintenance as a full unit. Isolation valves should be provided at the boundaries of engineered package units. Depending on the fluid conditions, consideration should be given to adding the capability for spading or blinding lines entering or leaving an engineered package at the skid edge.

For the packages, all vent / drain / flare / utility connections will be grouped within the package and provided with common isolation at the package battery limit.

For major process packages having multiple equipment e.g., Glycol Unit containing significant inventory, individual equipment isolation shall be provided as per Table 9.1.

Equipment within the same package such as pumps, compressors and air coolers shall comply with the isolation requirements explained in Sections 9.4 through 9.8.10.

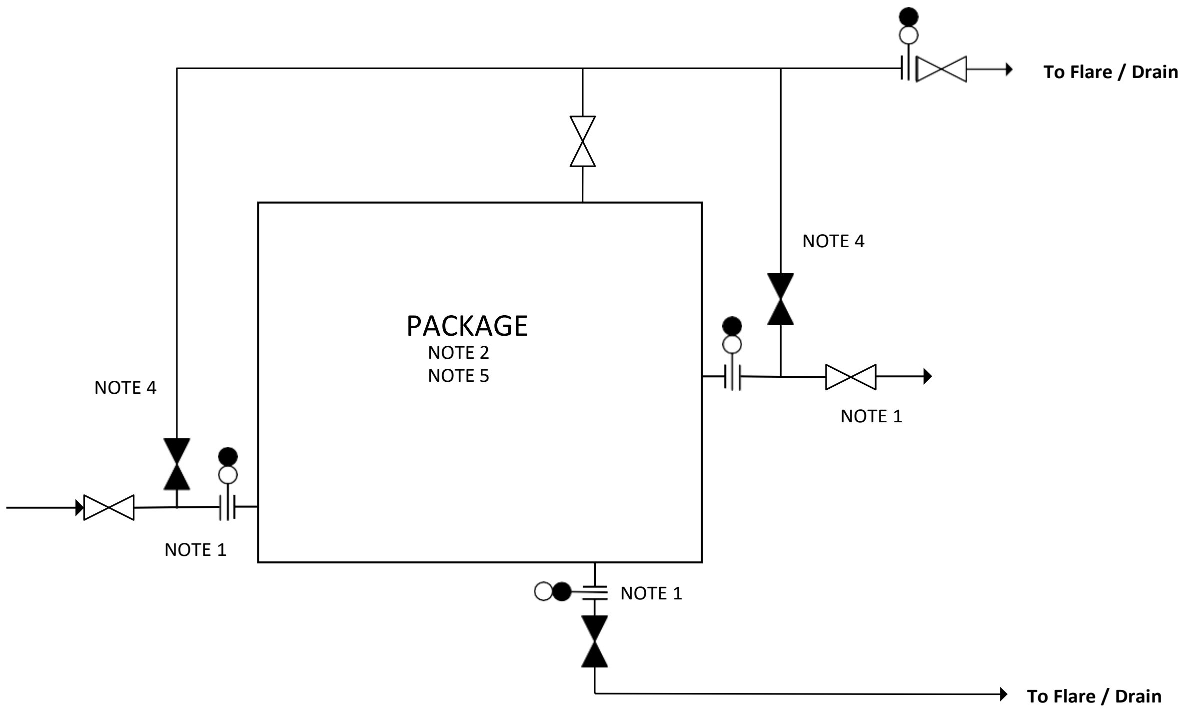

Figure 9.27 Package Isolation – Single Block and Bleed Isolation.

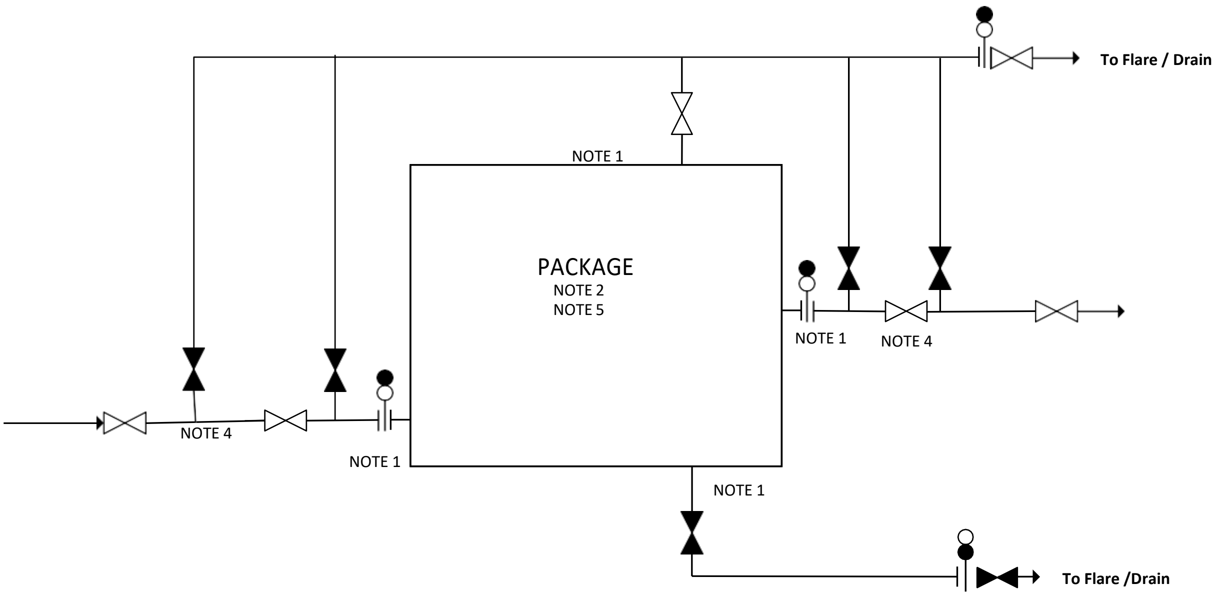

Figure 9.28 Package Isolation – Double Block and Bleed

Note 1: Positive isolation is achieved by using Removable spool, Spectacle Blind, Spacer based on piping design consideration. In case the isolation valve cannot be located close to package nozzles, the positive isolation may be achieved by Removal Spool to reduce the inventory loss.
Note 2: Individual package isolation for maintenance may not be required where complete shutdown of train/unit is required for maintenance. In such cases unit/train isolation may be achieved (SBB or DBB) as per Table 9.1.
Note 3: Special consideration should be given to the installation of spool pieces between large bore valves (definition of large bore will be project specific), in order to facilitate safe removal of equipment.
Note 4: Valve types shall be based on the project specific requirement. Refer to Table 9.1 for the isolation requirements which shall also be applicable to the bleeds.
Note 5: Applicable to small packages e.g., chemical Injection etc
Note 6: These sketches are not a replacement for P&ID details and only address isolation

9.8.12 Future Tie-Ins

Appropriate tie-in provisions should be provided for connecting future facilities. However, considering very long periods and consequent potential risk of corrosion and leakage of isolation valve at the tie-in point, flanged connections terminated with rated blind is to be provided. Dead ends are to be minimised when future tie-ins are installed.

9.8.13 Purging

Systems suitable for isolation shall be provided with valve connections to allow purging with utilities such as nitrogen and steam via flexible hose, either from utility stations or permanent hard pipe connected to the equipment. Purging is required to displace hydrocarbon gas and/or H_2S.

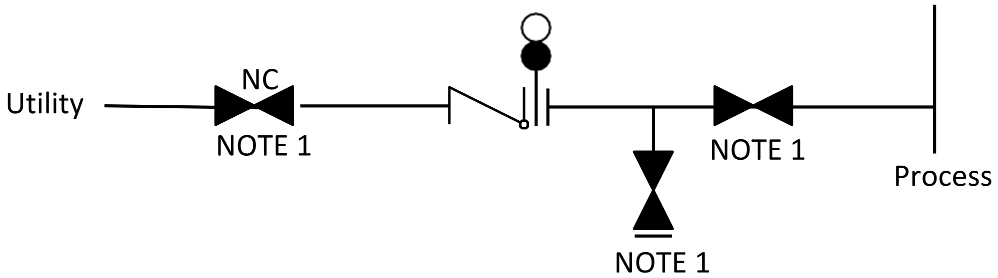

Figure 9.29 Single Block & Bleed Isolation for Permanent Utility Connections

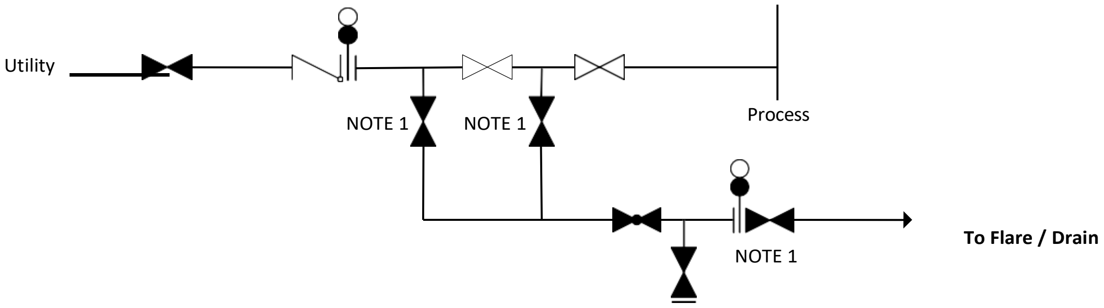

Figure 9.30 Double Block & Bleed Isolation for Permanent Utility Connections

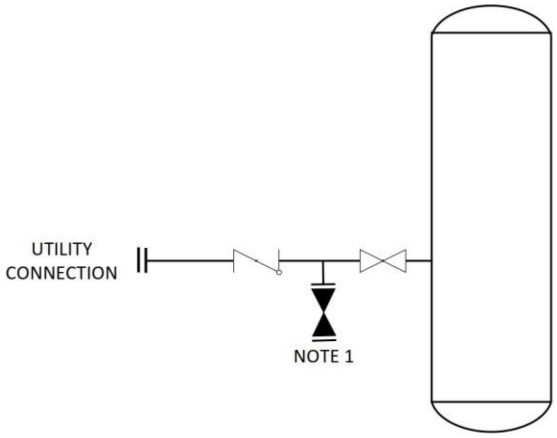

Figure 9.31 Single Block and Bleed for Utility Station with hose connection

Note 1: Valve types shall be based on the project specific requirement. Refer to Table 9.1 for the isolation requirements which shall also be applicable to the bleeds.

Note 2: These sketches are not a replacement for P&ID details and only address isolation

10 EQUIPMENT VENTS & DRAINS

10.1 Introduction

10.1.1 Operating Drains & Vents

An operating drain or vent is used when the equipment is in service. For example, a fuel gas knock out drum manual drain which is opened to reduce liquid level when the system is in service, is an operating drain. An exchanger vent which is opened to eliminate inert gases when the exchanger is in service is an operating vent.

10.1.2 Non-Operating Drains & Vents

A non-operating drain or vent is used when the equipment is isolated and not in service. A vent or drain used to depressurise and remove inventory during a shutdown is non-operating. A vent or drain used for hydrostatic testing is non-operating.

The system destination (closed or open) and the valve requirements are based on the function of the vent or drain system, and the material being vented or drained. More stringent design conditions are imposed on operating vents or drains in hazardous service because malfunctions can cause extremely negative consequences. After shutdown, systems will be depressurised, cooled and flushed with a non-hazardous fluid, before being vented and drained. Non-operating drains and vents used for hydrostatic testing are not used when the process fluid is contained in the equipment or piping.

10.2 Equipment & Piping

10.2.1 Drains

(a) Hazardous Service

Pipe to a closed drainage system.

Separate closed drain systems shall be provided for special chemical applications such as glycols, hot oil, spent oil, and amine.

Minimum drain size shall be 2 inch (unless source line is smaller than 2 inch), however larger size drains may be considered depending on the system volume and the fluid service and considering if there is any specific operational constraint on the draining time. Minimum underground header size shall be 4 inch.

A number of drain connections may be provided on vessels, particularly when fitted with internals, to ensure that each section of the vessel can be drained adequately.

(b) Non-Hazardous Service

Pipe to an open drainage system. However, steam condensate shall be routed to closed system.

Minimum drain size shall be 2 inch (unless source line is smaller than 2 inch). Minimum underground header size shall be 4 inch.

10.2.2 Vents

(a) Hazardous Service

Pipe to a closed system such as a flare system.

Hydrocarbon vapours, shall be piped to closed flare system. Toxic materials are usually piped to a separate designated closed disposal system.

Minimum size shall be 2 inch (unless source line is smaller than 2 inch).

(b) Non-Hazardous Service

Pipe to an atmospheric safe location or to the vapour space of the equipment from which a pump takes suction.

Minimum size shall be 2 inch (unless source line is smaller than 2 inch).

10.2.3 Specific Considerations

(a) Pumps

Where a pump has several drains, these may be manifolded together to a single connection to the drain system. This includes the casing drain.

If there is more than one pump in a set, each pump shall have a separate manifold with its own separate connection to the drain system.

Centrifugal pump casings shall have separate priming vent connections routed suitably (to closed / open drain system), even though the pump is self-priming type.

Startup vents are included in this category because the pump is in service when the startup vent is used. Operating vents shall be considered for services that are susceptible to vaporization in the pump suction piping. The requirement and location of operating vents are affected by the pump type and suction piping configuration and shall be discussed with the Machinery Group. Examples of services susceptible to pump cavitation which may require operating vents are the suction can of a vertical condensate pump taking suction from a steam surface condenser, cracking services (check with Process Design if the system contains a hydrocarbon fluid with a high suction temperature), and cold services (the fluid is vaporized by absorbing ambient heat).

(b) Heat Exchangers

Vents and drains on heat exchangers shall be avoided as much as possible. However, these are required in the following circumstances:

i. Vents and drains are required on the shell covers of Horizontal Floating Head Heat Exchangers
ii. Drains are required on the shell covers of Vertical Floating Head Heat Exchangers

Heat exchangers usually require hydro testing after tube bundle cleaning and other maintenance activities. For this reason, piping to both the shell and tube sides of heat exchangers shall be provided with high point vents and low point drains, unless venting and draining can be done via other equipment.

(c) Total Overhead Condensers

Provide a vent on the condensing side to remove the accumulated non-condensable material.

Pipe the vent to the reflux drum vapour space, if provision is made for the controlled release of non-condensable from the reflux drum, for example, a reflux drum vent with a control valve which opens the vent to flare at high pressure satisfies this requirement.

(d) Steam Surface Condensers

For steam surface condensers discharging to a condensate pot or float type trap, provide an equalising line between the equipment and the steam side of the exchanger and vent to atmosphere at a safe location.

10.2.4 Vessels

(a) Vertical Vessels

The vessel vent may be connected to the overhead line if the vapour line is connected to the top of the vessel and if that vent location adequately meets the venting and purging requirements for the vessel.

Locate the vessel vent on top of the vessel if the overhead line is connected to the side of the vessel.

(b) Horizontal Vessels

Providing a separate vent connection on the top of the vessel is preferred. However, a vent may be connected to the associated piping if that vent location adequately meets the venting and purging requirements for the vessel.

10.2.5 Drains

Drain connection should be connected at the lowest point to allow complete drainage of the vessel.

Where a process connection is provided at the vessel low point, the drain shall be incorporated on the piping upstream of the vessel isolation (process piping to be at least equal to the drain connection size) such that the liquid outlet piping is used for draining the vessel.

Where the lowest process line connection is on the side of the vessel, locate the drain on the vessel bottom.

Where the liquid nozzle has an internal standpipe, locate the drain on the vessel bottom. An anti-swirl baffle is not a standpipe, and therefore the drain may be connected to the bottoms line in that situation.

Vessels and Columns having skirt type support, shall have a drain at the bottom outlet line before the blind flange where the blind flange is located outside the skirt support. Any deviation from this requirement shall be submitted to COMPANY for review and approval.

Where a vessel is compartmentalized, for example by internal weirs, each compartment shall be provided with its own drain facility.

Vessels should be sloped to ensure complete drainage.

10.2.6 Piping

Vent connections shall be provided at the high point of piping 2 inch and larger, and drain connections on low points of all lines for process requirements. Critical multiphase piping mandating 'No pockets' shall be assessed with respect to the number of high point vents and low point drains.

No high point connections are required for air, inert gas and process gas piping systems, except for hydrostatic test purposes.

Vent and drain valves that are not piped away to suitable disposal systems, shall be fitted with blind flanges.

10.2.7 Control Valves

The following drains/vents will be provided for FC and FL control valves

Liquid Service - Drain Upstream & Downstream

Vapour Service -Vent Upstream & Downstream

Flashing Liquid Service

(Predominantly butanes and lighter) - Vent & Drain Upstream & Downstream.

However, fail open control valves only require a vent/drain downstream of the control valve because the valve has failed open/can be opened and the line upstream of the control valve can be drained through the control valve.

10.2.8 Low Temperature Systems

A dedicated low temperature cold drain system shall be provided for the low temperature areas such as Propane Recovery, Ethane Recovery, Alkylation unit etc.

11 DRAINAGE SYSTEMS

11.1 Purpose

Drainage systems serve the following purpose:

(a) Safety

To protect personnel, plant and equipment through a) preventing spillage or gas release to the environment and b) accumulation of hazardous liquid hydrocarbons, which could result in a fire or explosion.

(b) Environment
To minimize and/or to prevent direct discharge of environmentally hazardous streams to the environment by directing these streams to appropriate treatment units.

11.2 Classification

Drain Systems can be broadly classified as::

- Open drain /AOC
- Closed drain
- Process/drain BLOWDOWN – drain under pressure

11.2.1 Open Drains/AOC

These are defined as atmospheric drains which collect surface waste liquids. All the drain intakes (entry points) are permanently vented to atmosphere.

As a rule, facilities containing hazardous fluids or high volatility hydrocarbon liquids shall not be drained to the open drain system. This rule is applicable to all drains including instrument drains.

11.2.1.1 Open Drains,
Open Drains are exclusively for rain water and fire water collection. They are the wastewater drains in areas, where the risk for contamination with hydrocarbons or other oily products is minimal and can be disregarded.

Open drains are found in hydrocarbon liquid production, process and storage areas. Hydrocarbon liquids cover all crude oils and gas condensates, with the exception of high volatility hydrocarbon liquids.

Open drain water collected both onshore & offshore shall be further treated in a specifically designed oily water treatment unit, prior to disposal to the environment.

11.2.1.2 Accidentally Oil Contaminated (AOC)

AOC shall involve the surface run offs contaminated with hydrocarbons. They are wastewater AOC drains, which can be categorized as below:

a. Contaminated by very small amounts of hydrocarbons during normal operation or during other routine operations and considered in design.

b. Normally clean and for which contamination with liquid hydrocarbons can only result from an accidental leak (e.g. weld or gasket rupture) or a rare event (e.g. storm flooding and cross-contaminating normally clean areas).

c. Tundish/Chemical/Open Oil Drain System: drains from pump lube oil, base plate, chemical skids, drip pans, sample points, Pig scrapers, etc.

11.2.1.3 Categories in Operational Drains

Operational drains can be classified as:

(a) Manual Drains:

These can be operated manually using isolation or block valves.

(b) Automatic Drains:

Automatic drains are drains that can be operated without manual intervention by using automatic valve(s) and need careful evaluation before implementation.

11.2.2 Closed Drains

These are defined as fully contained hard piped drains, connecting the systems/equipment to be drained to the collection systems, before returning to the process or disposed of safely.

As a general rule, any facility containing hazardous toxic liquids which need to be drained for operational and maintenance reasons and may not be drained directly to atmosphere, shall be connected to a closed drain system. These are categorised as follows:

i. Closed drain system. These are maintenance drains (e.g., blowdown from pipeline section, residual drain from vessel after depressurisation).
ii. Maintenance drain (e.g., Pump lube oil system)

11.2.3 Process Drains

Some operations and equipment in the process facilities require periodic and partial draining during operation to keep them working at peak efficiency. This drainage often occurs when the connected system is still operational. These include level gauges flushing, compressor suction KO drums etc. Instrument drains are classified as process drains.

11.2.3.1 Instrument Drains

Hydrocarbon drain lines from level instruments and standpipes on a pressure vessel shall be combined wherever possible and routed to a closed process drain system.

A dedicated instrument drain line shall be provided with a block valve at the source and the second block valve at the header.

Instrument drains isolation shall preferably be provided with spectacle blinds in the open position to facilitate instrument flushing and for ease of operation (being a frequent operation and where very small volumes require to be flushed). The position of the spectacle blinds may be finalized based on the individual Company operating practices and risk assessment.

For more details on the instruments configuration, please refer to Section 9.8.7.

11.2.4 Segregation of Drainage Systems

Segregation of various drain effluents is very important from the viewpoint of safety in oil and gas installations. Therefore, segregation shall be considered as early as possible in the design of drainage systems.

Closed drains shall be completely segregated from open drains in order to prevent (pressure-driven) hydrocarbons from returning from the closed drains up through the plant via the open drain systems.

The piping networks hooked to the closed drains and open drains shall be independent. No inter-connections are permitted.

The closed drain drum (receiver) shall not receive any effluents from the open drain system directly and shall not discharge into an atmospheric receiver. Generally, for offshore platforms, the open drains shall be collected in an open drain drum. The open drain drum contents can be transferred to the closed drain drum, if the following conditions are met:

i. Double dissimilar check valves are used at the discharge of the open drain drum transfer pump connecting to the closed drain drum;
ii. The design is to be reviewed during HAZOP / LOPA to ensure safety to personnel and environment and identify measures to be added to mitigate hazards (if required).

11.2.5 Segregation of Closed Drain Headers from Process Drain Headers.

A common drum can be provided subject to having dedicated nozzles for each of the closed drain and process drain headers.

For process drain headers, each header shall be fully rated up to the last isolation valve upstream of the drum’s inlet nozzle such that the headers are not interconnected for overpressure protection.

Hazardous and non-hazardous area drains shall be completely segregated in order to remove the risk of hydrocarbon gas migration from hazardous areas to non-hazardous areas. This categorisation is necessary since the probability of ignition of a flammable atmosphere will be higher in areas classified as non-hazardous.

Main drain headers from hazardous and non-hazardous areas may all discharge into a common oil trap or oily water treatment facility, provided the conditions mentioned below are fulfilled:

i. Headers from hazardous areas are not connected to headers from non-hazardous areas, and each header enters the common treatment facility via its own dedicated inlet nozzle
ii. Hydraulic seals are provided at the inlet of the trap or treatment facility. It means that the drain header from the non-hazardous areas shall be sealed at entry in the drain receiver.

11.2.6 Piping Design

The design of the drainage systems shall minimize the presence of stagnant hydrocarbon mixtures (e.g. liquids, emulsions and solid residues) on surfaces and inside the collection system.

Evacuation of drainage effluents shall be by gravity.

Gravity pipe runs shall be designed to accommodate maximum expected flow with partially full (0.9d or less) pipes.

Restrictions shall be avoided in piping. As a general rule, 45° branching to be provided instead of 90° tees as there is potential for clogging.

Other than siphons and seal pots (or manholes onshore), drain headers shall contain no pockets and continuously slope towards a drain drum or oily water treatment facility.

The required minimum gradients of horizontal piping are specified below (for gravity-type drains, non-flooded pipes):

Table 11.1: Piping gradients for drainage systems

Type of Installation	Line Size	Minimum gradient
Onshore	Φ≥ 18’’	0.2%
	18’’ > Φ ≥ 6’’	0.4%
	6’’ > Φ ≥ 3’’	1.0%
Offshore pre-fabricated module	Φ ≥ 3’’	1.0% + hook-up tolerance
Offshore	Φ ≥ 3’’	1.0%

WHERE ANY OF THE ABOVE SLOPE REQUIREMENTS CAN NOT BE MET, COMPANY APPROVAL IS REQUIRED.

11.3 Onshore Open Drain Systems

All installations producing or processing crude oils, and most of the installations handling gas condensates shall be provided with an oily-water treatment unit.

Exceptions for not providing treatment facilities are:

i. Gas plants which do not handle hydrocarbon liquids in significant quantities;
ii. Onshore well head clusters and/or production manifolds located far from the processing centre. At these installations, drainage effluents may be collected in a dedicated open drum, which is periodically offloaded to an external oily water treatment facility.

All AOC drains shall be routed to an oily water treatment facility.

As a minimum, oily water treatment shall consist of a primary treatment facility such as an API separator.

Hydraulic seals and vents shall be installed within the drain systems as barriers against gas migration and spread of fire.

If discharge is permissible, vent pipes shall discharge to atmosphere, clear of areas accessible to personnel and away from permanent sources of ignition (at safe location). Particular attention shall be given to ensure that vapours cannot be admitted to buildings via air intakes or windows. Vents shall be a minimum of 5 m from such openings.

Each drainage header shall be provided with isolation (valves or blinds and/or spacers) as required for isolation and maintenance of the collection tanks.

11.4 Onshore Closed Drain Systems

11.4.1 General

The design of closed drain systems shall be based on maximum operating temperature and not the design temperature of the connected process systems. The piping upstream of the closed drain drum shall have the same design temperature as the process system/equipment connected to. The design temperature of the process system/equipment shall be based on the maximum expected operating temperature plus a margin as required or the steam-out temperature, whichever is higher (refer to Process Design Criteria [3] for the design temperature margins). The maximum and minimum design temperatures for the closed drain should match or exceed the expected temperatures of the hottest and coldest effluents that will drain into the vessel. It should also match the hottest and coldest temperatures expected due to relieved material entering the vessel from the flare system as could occur during relief events.

11.4.2 Piping Design

i. Closed drain piping shall follow the piping specification for the fluid service;
ii. Positive isolation shall follow the isolation philosophy in Section 9 of this specification;
iii. Pipe diameter and design conditions shall follow the Process Design Criteria [3];
iv. The collection and treatment of drains shall be segregated such that icing may not occur. Cold drains (handling LNG, refrigerated LPG or NGL) shall not be mixed with wet drains;
v. Maintenance drain connections shall be provided with SBB or DBB as per Table 9.1, and a spectacle blind in closed position (normal operation) is to be provided;
vi. Minimum diameter of DN 50 (NPS 2) shall be used for all drain lines unless protection and/or support is provided to withstand loads and impacts associated with nearby maintenance activities;
vii. Sizing of the closed drain header piping shall be such that the main drain header piping is a minimum of one size larger than the connecting drain line at each junction to prevent clogging.

11.4.3 Drum Design

1. Sizing

Liquid capacity of the drum should be sufficient to handle the largest credible drainage volume from the single largest drum (i.e. the liquid level below LALL of the largest vessel or the longest isolatable piping segment or equipment item.) The liquid capacity of the closed drain drum is the internal volume between the level trip points.

If the size of the closed drain is significantly increased by the drainage volume of a large process vessel, alternative drainage routes and strategies should be assessed for the source drum. If incorporated in the design, alternate drainage routes should be risk-assed with emphasis on HP to LP interfaces and material compatibility..

2. Further Handling from Closed Drain Drum

The contents of the closed drain drum shall be transferred using one of the following two methods:

i. Pumps;
ii. Vacuum sucking

If the pumping option is selected, a minimum of two pumps (one operating and one standby) shall be provided. Operation of the pumps shall be by means of level transmitters providing start/stop action for the pumps. High level will start the pump and the pump will stop at low level. After starting of the first pump, if the level continues to rise, then at high high level the second pump shall automatically start (lead/lag arrangement).

The upstream and the downstream systems shall be designed for the scenario of both pumps running.

The pumps should be of low shear impeller design to minimize oil emulsification. Low speed centrifugal pumps with operating speeds are recommended.

The closed drain drum shall not be connected to mobile facilities for removal of the closed drain drum liquids.

A gully sucker connection is required to remove residual liquid / sludge for the maintenance requirements of the drum.

11.5 Offshore Drainage Systems

A typical system is shown in the diagram below:

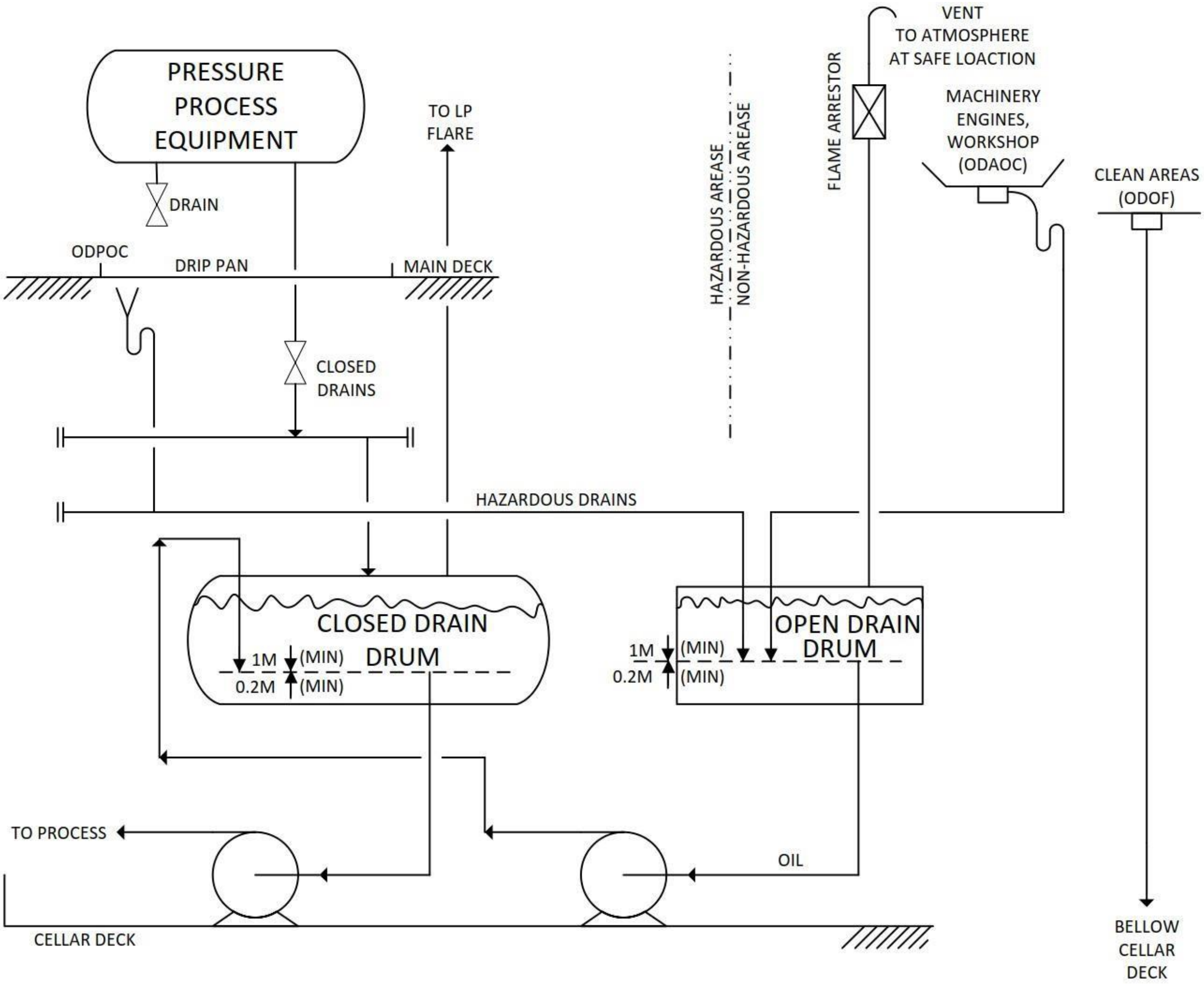

Figure 11.1 Typical Offshore Drainage System

On production, process and utility platforms, drains shall normally be classified/configured as follows:

(a) Hazardous Area Drain:

These are the open drains in the hazardous areas i.e. the hydrocarbon liquid production and process areas.

These drainage fluids shall be collected together in the same header and sent to an atmospheric tank (referred to as open drain drum). Seal pots shall receive effluents from each drain sub-header to allow any gases dissolved to vent away from ignition sources. The main collection header(s) connecting the open drain drum shall be sealed on entry.

(b) Non-Hazardous Area Drains:

These are the drains in the non-hazardous areas where equipment not handling hydrocarbons can still generate oily wastewater.

These are all AOC drains and shall be routed to the open drain drum with a separate nozzle and seal arrangement, dipping lower in the drain tank than the hazardous header.

(c) Clean Water Drains:

These collect oil-free water from clean surfaces such as:

From module roofs.
From open deck areas, which are unlikely to be contaminated (e.g. lay-down areas such as on weather decks, deck peripheral areas outside equipment modules or far from machinery and process equipment).
Firewater/Rainwater from the hazardous areas.

These shall be collected and piped directly to sea. The outfalls shall be open ended below the level of the lowest, routinely accessible deck referred to as “cellar deck”. As an exception to this rule, single deck platforms may discharge their fire and rainwater directly overboard.

11.6 Collection of Drainage Effluent

There are three main types of collection points for effluent entering the drainage system:

i. Tundishes
ii. Gullies
iii. Drain Boxes

11.6.1 Tundishes

Tundishes are open pipe connections that collect drips from “equipment drains”, sample draw-off points, instrument drains and generally all point-type sources of oily drips and spillage.

i. The lip of the tundishes should be located minimum 50 mm above deck level to prevent flooding of oily water drain systems with rain/fire water;
ii. The height of all tundishes used in deck drains should be kept as low as possible and they should be installed at an approximately equal elevation to minimise the possibility of liquid backflow;
iii. All tundishes shall be fitted with covers when not in use to prevent debris or in some cases rainwater from entering the pipework;
iv. Valves should not be used in pipework below the tundishes to restrict backflow due to operability and cost disadvantages;
v. Where a drain line runs to a tundish, the end of the drain line shall terminate inside the tundish, not above it, to avoid splashing and spread of the drained fluid;
vi. Tundishes beneath sampling points shall have a side-entry slot to allow insertion of sample bottles;
vii. The piping to the tundish should be routed from the bottom of a drip pan to minimize the volume of liquids from collecting in the drip pan;
viii. When piped to a drain header, the connection shall be flanged. This allows the tundish connection to be blinded off for pressure testing the drain piping and also provides a flushing connection for clean-out.

11.6.2 Drip Trays

Drip trays shall be installed under equipment, such as pig traps, where spillage of hydrocarbon liquids is possible. One drip tray should be dedicated to one major item of equipment, however for small, closely grouped independent equipment handling compatible fluids (e.g. very small pumps) a common drip tray may be used.

i. Strainers shall be installed over the drip tray drains to prevent solid contaminants from entering the piping system;
ii. The flange facings on drip tray drain connections shall be flat faced when bolted to fiberglass flanges;
iii. Drip trays should only be installed under those parts of the equipment that may potentially leak and not under complete equipment skids since this could lead to excessive loading on the drain system during periods of heavy rain;
iv. Drip trays shall be designed with a minimum 2% slope.

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Table 11.2: Sources and destinations of offshore drainage systems fluids

Sources		Expected Components	Destination		
			Open Drains		Closed Drains
			Non-Hazardous	Hazardous	
1	Process equipment and lines containing hydrocarbons for maintenance purpose	Oil, condensate, water, sand, gas	---	A+B	A(1,2)
2	Process drains from pressure vessels	Oil, condensate, water, some gas, produced water	---	---	A(3)
3	Drip Trays under Process equipment	Oil, wash water	---	A	---
4.	Drains from aviation fuel storage drip-trays	Aviation fuel, water	---	A	---

5	Drains on/overflows on diesel fuel tanks/systems.	Diesel fuel, wash water	---	A+B	---
6	Drains on compressor seal oil tanks, pump seal drain.	Oil/ condensate + gas	---	A	A(5)
7	Drip trays under chemical storage tanks/ vessels	Lubricating oil	A	A	---
8	Floor drains in Hazardous area	Small Quantities of spilled chemicals, wash water	A	A	---
9	Floor drains in Non- Hazardous area	Spilled lube oil, wash water, rain water	---	A	---
10	Floor Drains in Hazardous area	Spilled lube oil, wash water, rain water	A	---	---
11	Instrument drains (typically level instruments from process equipment)	Oil	---	A	A(1,2,7)
12	Flare Knockout Drum	Oil, water	---	---	A
13	Discharge of thermal relief valve in hydrocarbon process equipment/ piping	Oil water	---	A	A(1,2)
14	Deluge Drains (6)	Firewater	Direct overboard to sea		
15	Roof & Outside deck drains (oil free areas) (non-hazardous	Rainwater	Direct overboard to sea		
16	Helldeck drains	Rainwater, spilled fuel	A	---	---

11.6.3 Drum Design

The drain drum transfer pump suction take-off shall typically be extended 8 inches or more above the drum bottom to prevent solids/sludge entering the pump.

The atmospheric vent line from the open drain drum shall be routed to a safe location.

The hazardous area open drain header and the non-hazardous area open drain header shall enter separately into the open drain drum, and the non-hazardous area open drain header shall be sealed on entry. The minimum seal depth shall be 1 m.

11.6.4 Closed Drainage

i. In the case of maintenance drains, it is important to note that the equipment to be drained to the closed drain system shall be isolated and depressurised before the start of draining;
ii. All drainage to the closed drain drum should be by gravity flow;
iii. The closed drain drum liquids shall be returned (pumped) back to the process;
iv. The open drain headers shall not be connected directly to the closed drain drums;
v. The pumped transfer line from the open drain drum to the closed drain drum shall be dipped and sealed in the liquid of the closed drain drum. The minimum seal depth shall be 1 m and the minimum distance between the dip pipe outlet and closed drain drum bottom surface shall be 8” (200 mm) to prevent obstruction by sludge or solids;
vi. The capacity of the closed drain drum shall be such that it can accommodate the hold-up of the largest residual inventory (draining to the closed drain drum) from the Low Low Level to the bottom of this vessel.

11.6.5 Wellhead Towers

The WHT shall be provided with a single drain collection vessel, which shall be designated as “Drainage Sump Tank”.

Separate closed drain header and open drain header shall be provided to collect the drained fluid at different locations. Both the open drain and closed drain shall be routed to the “Drainage Sump Tank”.

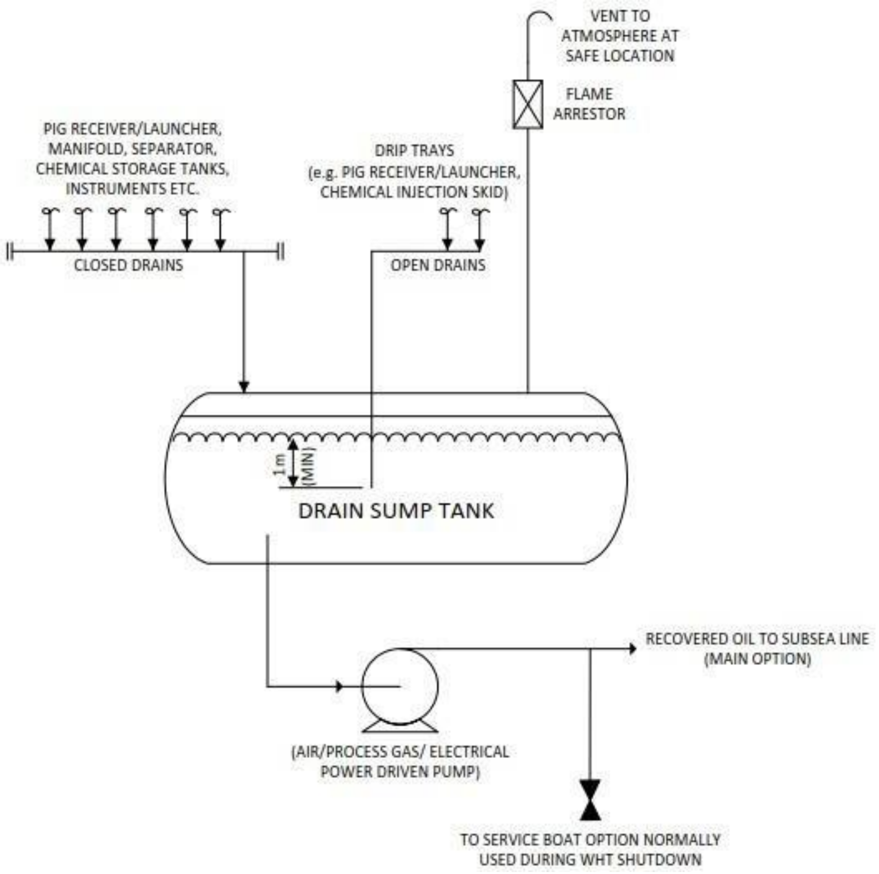

Figure11.2 Drainage Sump Tank

11.6.6 Closed Drains on WHT

Closed drain piping network shall collect, in general, the following liquid content:

i. Drain contents from production header after depressurisation;
ii. Drain contents from multi-phase flow meter/test separator manifold after depressurization and prior to maintenance;
iii. Drain contents from chemical storage tanks;
iv. Drain contents from the annuli bleeds;
v. All pig traps (launchers and/or receivers) on the WHT prior to maintenance;
vi. Drain contents from high-pressure instrument drains (e.g. level instrument of hydrocarbon equipment such as a test separator).

All closed drain connections shall be hard piped from the equipment, hydrocarbon piping, instruments etc. to the closed drain main header keeping the hazardous hydrocarbon liquids out of contact with the atmosphere.

The closed drain system shall be a gravity-based system draining to the “Drain Sump Tank”.

Open drain header shall collect, in general, the following liquid content:

i. Pig Launcher/Receiver drip trays;
ii. Chemical Injection Skid drip tray.

The open drain header shall be a totally independent header routed to the "Drain Sump Tank". This header shall be sealed on entry into the drain sump tank. The minimum seal depth shall be 1 m.

11.6.7 Drainage Sump Tank

It should be located on the lowest deck of the WHT platform to facilitate gravity draining.

The recovered oil contents of the drain sump tank can be routed to the subsea line through a pump (either electric power driven, or process gas driven). If the WHT is not in operation, the drain sump tank liquids shall not be pumped into the subsea line and shall be emptied into a tank on a boat.

As an alternative, the drain sump tank disposal system may be designed entirely for collection on a boat.

The following options may be exercised for transferring the drain sump tank liquids to the boat:

i. Fixed pump on WHT platform (gas driven);
ii. By a portable pump (air driven with air supplied from service boat);
iii. Fixed pump on WHT platform (air driven with air supplied from service boat);
iv. Electrical motor driven pump installed on WHT for the case where WHT has electrical power supply available;
v. Transfer to boat by gravity, which requires adequate elevation difference between the drain sump tank and the boat

The vent from the drain sump tank shall be an atmospheric cold vent at a safe location downwind of the prevailing wind direction and as far away as possible from the boat landing stage. Dispersion analysis shall be done to determine the atmospheric cold vent height.